VOL. LXXX PART TEN

JOURNAL OF THE ROYAL HORTICULTURAL SOCIETY

OCTOBER 1955

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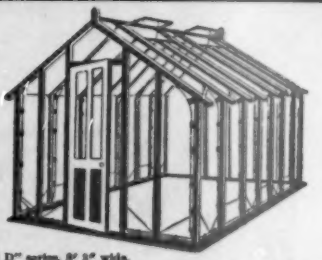

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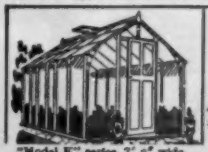

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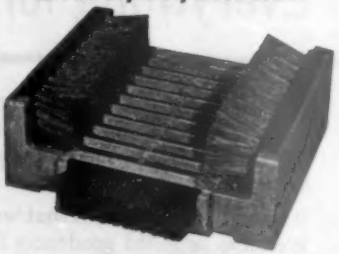

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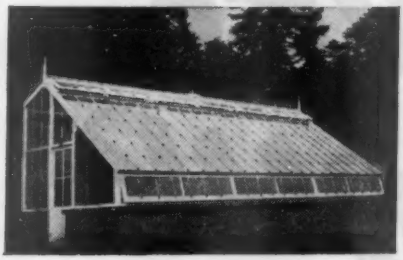

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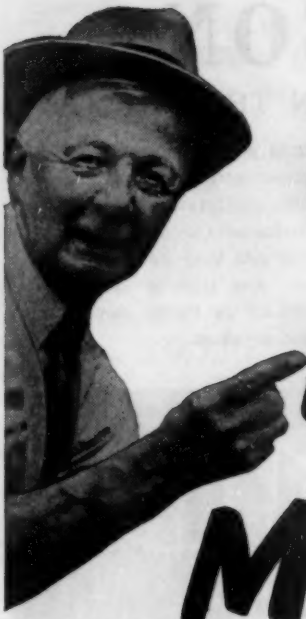

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JOURNAL OF THE ROYAL HORTICULTURAL SOCIETY

VOL. LXXX PART TEN

October 1955

THE SECRETARY'S PAGE

ANNOUNCEMENTS—OCTOBER AND NOVEMBER

Shows

TUESDAY, OCTOBER 4 12.30 P.M. to 6 P.M. WEDNESDAY, OCTOBER 5 10 A.M. to 5 P.M.	Fortnightly Flower Show. Fruit and Vegetable Show.
TUESDAY, OCTOBER 18 12 NOON to 6 P.M. WEDNESDAY, OCTOBER 19 10 A.M. to 5 P.M.	Fortnightly Flower Show. Tree and Shrub Competition.
TUESDAY, NOVEMBER 1 12 NOON to 6 P.M. WEDNESDAY, NOVEMBER 2 10 A.M. to 5 P.M.	Fortnightly Flower Show. British National Carnation Society's Competition.
FRIDAY, NOVEMBER 4 1 P.M. to 7.30 P.M. SATURDAY, NOVEMBER 5 10 A.M. to 6 P.M.	National Chrysanthemum Society's Show.
TUESDAY, NOVEMBER 15 12 NOON to 6 P.M. WEDNESDAY, NOVEMBER 16 10 A.M. to 5 P.M.	Fortnightly Flower Show.
TUESDAY, NOVEMBER 29 12 NOON to 6 P.M. WEDNESDAY, NOVEMBER 30 10 A.M. to 5 P.M.	Fortnightly Flower Show. Late Apple and Pear Competition.

Lectures

TUESDAY, OCTOBER 4, at 3 P.M. "Wall Fruit," by MR. F. J. ROSE, V.M.H.

TUESDAY, OCTOBER 18, at 3 P.M. "The Choice and Care of Trees for Small Gardens," by MR. F. P. KNIGHT, F.L.S.

TUESDAY, NOVEMBER 1, at 3 P.M. "Vegetables for the Connoisseur," by MR. F. G. POTTER.

TUESDAY, NOVEMBER 29, at 3 P.M. "The Control of Vegetable Pests," by MR. D. W. WRIGHT, M.A.

Demonstrations at Wisley—The following demonstration will be given at Wisley, that on the second day being a repetition of that given on the first.

Fruit Garden

NOVEMBER 23–24. The Pruning of Fruit Trees. (Commencing at 11 A.M.)

Admission to the Gardens at Wisley—The Council has decided as an experiment to open the Gardens to Fellows on Sundays throughout the winter. The times of opening of the Wisley Gardens on Sundays will now be as follows:

From the second Sunday in March to the last Sunday in September from 2 P.M. to 6 P.M.; on other Sundays (excluding Christmas Day) from 2 P.M. until 5 P.M. or sunset, whichever is the earlier.

Restaurant at Wisley—The Restaurant at Wisley will be closed after October 30. It will re-open in 1956 on a date to be announced.

Floral Arrangement Exhibition—There will be an exhibition of Floral Arrangements in the New Hall on October 7 and 8. Proceeds will be donated to the Gardeners' Royal Benevolent Institution in aid of the Hospital Annexe at the Institution's Country Home. Schedules and full particulars may be obtained from the organizer: Miss Julia Clements, 132 Sloane Street, S.W.1 (SLO 6350). Admission charges are: October 7, 12 NOON–5 P.M. 3*s.* 6*d.*, 5 P.M.–7 P.M. 2*s.* 6*d.*; October 8, 10 A.M.–1 P.M. 2*s.* 6*d.*, 1 P.M.–5 P.M. 1*s.* 6*d.*

Results of the Society's Examinations held in 1955

General Examination—At the General Examination in Horticulture, held on March 9, 1955, there were 809 candidates, of whom 460 were successful—39 being placed in Division I and 421 in Division II; 349 candidates failed to satisfy the Examiners.

At the General Examination in Horticulture for Juniors (i.e. those under 18 years of age on March 1, 1955), which was also held on March 9, 1955, there were 341 candidates, of whom 149 were successful; 192 candidates failed to satisfy the Examiners.

Both these examinations consisted of written work only.

Examination for the National Diploma in Horticulture—This is the most important of the Examinations conducted by the Society, and is intended for the professional horticulturist. Candidates for the Examination must produce evidence of having followed the vocation of horticulture for specified periods. Both the Intermediate and Final Examinations involve practical tests, conducted at Wisley and elsewhere, as well as written work.

In 1955 there were 136 candidates for the Intermediate Examination, of whom 52 acquitted themselves sufficiently well to be allowed to take the Final Examination in due course. For the Final Examination there were 66 candidates, and in the Sections which have so far been completed, the Diploma has been awarded to the following 29 candidates:—

Section I—*General Horticulture*

MR. M. M. ANDERSON
MR. J. J. C. BLACK
MR. H. BRACEWELL
MR. W. BROWN
MR. J. R. S. BULFORD
MR. C. J. CARTWRIGHT
MR. J. CHAPMAN
MR. K. G. CLARKE
MR. G. F. A. GRUBB
MR. B. HALLIWELL
MR. P. HOWARTH
MR. P. J. JEW
MR. G. H. KING
MISS G. E. PETERSON
MISS P. H. SCHWERDT
MRS. M. C. SMITH
MR. J. T. WARREN
MR. R. F. WILLIAMS
MR. J. P. WOOD

Section II—*General Commercial Horticulture*

MR. D. J. FULLER
MR. A. A. ORGAN
MR. J. PEARSON
MR. F. E. SKINNER

Section V—*Glasshouse Crop Husbandry*

MR. F. H. OLVER
MR. P. WILSON

Section VII—*Horticulture in Public Parks*

MR. K. EVANS
MR. P. C. HUGGETT
MR. F. A. JACKSON
MR. G. W. WRIGHT

National Diploma in Horticulture with Honours

MR. A. J. BEDDING
MR. S. R. G. DOWNS

Examination for the National Certificate in Elementary Horticulture—This Examination, which includes both written and practical tests, was held in 1955 at sixteen County Institutes. In all there were 197 candidates of whom 179 were successful, 26 having obtained a pass with credit.

INVITED TRIALS, 1956–7

The Royal Horticultural Society will carry out during the season 1956–7 the following trials, for which entries are invited.

Flowers

Arctotis ($\frac{1}{8}$ oz. of seed of each variety).
Coreopsis, annual ($\frac{1}{8}$ oz. of seed of each variety).
Godetia ($\frac{1}{8}$ oz. of seed of each variety).
Lobelia, annual (sufficient seed to raise 60 plants of each variety).
Polyanthus ($\frac{1}{16}$ oz. of seed of each variety).
Primrose ($\frac{1}{16}$ oz. of seed of each variety).
Salpiglossis, to be sown in the open ($\frac{1}{16}$ oz. of seed of each variety).
Salvia splendens, bedding varieties only (sufficient seed to raise 60 plants of each variety).

Vegetables

Celeriac ($\frac{1}{4}$ oz. of seed of each variety).
Climbing French Bean ($\frac{1}{2}$ pint of seed of each variety).
Cucumber, ridge, sown in the open (100 seeds of each variety).
Melon, varieties suitable for cultivation under Dutch lights (20 seeds of each variety).
Onion, spring sown (1 oz. of seed of each variety).
Runner Bean ($\frac{1}{2}$ pint of seed of each variety).

Conditions for entry to the Trials

1. All entries must be made on the appropriate form obtainable from the Director, The Royal Horticultural Society's Gardens, Wisley, Ripley, Woking, Surrey.

2. Entrant must certify on the form either:

(*a*) that the variety or strain has been raised or developed by him;
or (*b*) that the variety or strain was, or is about to be, introduced by him to British commerce.

The entrant must also supply sufficient particulars of the history of the variety or strain to substantiate his certificate, but such particulars will not be published by the Society without the sender's consent.

3. Entry forms must be completed and returned to Wisley not later than December 31, 1955.

4. Seeds should not be sent until the entrant receives notification that his entry has been accepted.

5. In the event of too many entries being submitted for a particular trial the Council of The Royal Horticultural Society reserves the right to scale down the number of entries received.

Calendar of Invited Trials

1956	1957	1958
	Flowers	
Anemone japonica (*A. hupehensis* var *japonica*)	Calendula	Antirrhinum, rust resistant varieties
Arctotis	Carnation, annual	Clarkia
Coreopsis	Freesia, from corms	Dahlia, dwarf bedding types
Godetia	Polyanthus	Nicotiana
Lobelia, annual	Primrose	Penstemon
Salpiglossis	Scabious, annual	*Senecio cruentus*
Salvia splendens	Tagetes	
Trollius	Verbena, from seed	
Wallflower		
	Vegetables	
Broccoli	Beet long varieties	Carrot, maincrop
Celeriac	Cauliflower, autumn varieties	Cauliflower, early varieties
Climbing French Bean	Lettuce, cabbage, summer butterhead varieties	Celery, self-blanching
Cucumber, ridge		Corn salad
Kale		Pea, early varieties
Onion, spring sown	Lettuce, cos, autumn sown	Tomato
Runner Bean	Pea, late varieties	
	Under Dutch Lights	
Lettuce	Carrot	
Melon	Beet, round varieties	

NOTE.—The years refer to those in which the trials will be judged. The calendar for 1957 and 1958 is provisional and may be altered.

NOTES FROM WISLEY

J. B. Paton

THE chief interest in the Gardens during October is the autumn colour provided by the berries and the leaves of the trees and shrubs. The berried shrubs were discussed last year and so this month the notes will be confined to plants particularly noted for their autumn leaf colours. The exact nature and cause of this phenomenon is not completely understood, but a brief review of some of the basic facts was given in these notes in October 1953 and now mention will be made of a further selection of plants which show these colours.

The Japanese *Acer japonicum* makes a small bushy tree on which are produced seven- to eleven-lobed soft green leaves which turn a bright crimson in the autumn. There is also to be seen on Battleston Hill the variety *aconitifolium* whose leaves are deeply divided, sometimes almost to the base. An interesting maple to be seen in Seven Acres is *A. tataricum*, coming from Eastern Europe and Western Asia; it has a very distinct foliage which is similar in shape to that of *Holodiscus discolor* and which dies off in yellow and reddish-brown tints.

The well-known *Sorbus discolor* is represented by a specimen tree in the Award of Garden Merit Collection. It has pinnate leaves which turn a glorious red in autumn. In Seven Acres the Chinese *S. folgneri*, introduced by WILSON in about 1901, makes a graceful tree with arching branches on which are carried simple leaves vividly white beneath and wonderfully coloured in autumn.

Leaving the Award of Garden Merit Collection and proceeding along the path towards the Herbaceous Borders there may be seen a fine specimen of *Liriodendron tulipifera* which in October 1954 was a most marvellous sight when all its leaves had turned yellow. There is on the lawn in front of the Restaurant a young specimen of this species which was planted by HER MAJESTY QUEEN ELIZABETH THE QUEEN MOTHER when she opened the new building. This tree is also of interest in June and July when there appear the curious flowers coloured greenish-white banded with orange. Also in this part of the Gardens is a collection of viburnums, of which the following species are noteworthy for their autumn leaf colour. *Viburnum alnifolium*, the American hobble bush, is usually a star-turn in this collection with a mass of colour in varying hues of red, bronze, orange and yellow, while the native *V. opulus*, the guelder rose, must be considered a first-rate shrub for any garden, both on account of its foliage and its bright red globose fruits. There is also the snowball tree, *V. opulus sterile*, and a very similar shrub, *V. sargentii*. The latter, however, grows larger and on alkaline soils produces in autumn wonderful leaf colour in shades of red and orange.

Before arriving at the Gardens visitors will have passed along the road which is lined with many silver birches, *Betula pendula*, whose leaves have a marvellous range of golden yellow and pale brown colours which show up to perfection on a sunny day. In the Gardens themselves there is a considerable number of other birches, all of which are worth seeing at this time of year. These include *B. ermani* from Eastern Asia, *B. nigra* from North America, and two weeping varieties, *B. pendula dalecarlica*, the Swedish birch, and *B. pendula purpurea*, also known as Young's weeping birch.

From Eastern Asia *Cercidiphyllum japonicum* is worth noting on account of its carmine-coloured, heart-shaped leaves. There appear to be two forms of this shrub, the Chinese with carmine leaves and the hardier Japanese with yellow ones. It is a tree which commences its growth early in the season and, so, to avoid damage by spring frosts it

should not be planted in exposed situations. The thorns, however, may be planted in any position and are beautiful in autumn with their coloured fruits, but the only one of note at Wisley for its leaf colour is *Crataegus prunifolia* with leaves of a rich glowing crimson. The origin of this tree is somewhat in doubt, but it is normally considered to be a wild hybrid between *C. crus-galli* and *C. macracantha*.

The spindle trees are well known in our hedgerows and are detested by many gardeners as the host plant of the blackfly, but there are some fine species of *Euonymus* for autumn colour. One of them is *E. alatus*, from China and Japan, with rich rosy scarlet leaves, which is the most distinct species in the genus on account of the curious corky wings which develop on the branches. There may also be seen a variety of it known as *apterus* in which the corky wings are missing and the leaves are thinner and longer. Also from Japan *E. yedoensis* carries brilliant red leaves in the autumn months. The varieties of the native spindle *E. europaeus* are mainly noted for their decorative fruits.

Two genera which are not so commonly cultivated are *Gleditschia* and *Koelreuteria*. *Gleditschia* is a small genus which belongs to the family Leguminosae and which has a fairly wide distribution from North America through Western Asia to Japan. Two species, *G. caspica* and *G. triacanthos*, are represented in the Gardens and of these only the American *G. triacanthos* is notable in the autumn. It is commonly known as the honey locust on account of the likeness of the tree in foliage to the locust (*Robinia*) and the thick succulent sweetish pulp in which the seeds are set. The leaves are 4–8 inches long, either singly or doubly pinnate, resemble the foliage of a fern and turn a clear bright yellow in the autumn. The Chinese *Koelreuteria paniculata* also has leaves which change to a bright yellow as the days shorten. This is a tree which may be propagated by root cuttings, a method of propagation which is not very commonly used.

Of smaller dimensions than the last two plants are *Neillia thibetica* with yellow autumn leaves and *Pistacia chinensis* with foliage that changes to a gorgeous crimson before falling. Both these plants come from China and the latter is used by the Chinese as a food, the young leaves being eaten cooked as a vegetable. Of the cherries the native gean *Prunus avium* is, in autumn, one of the most attractive of our woodland trees. However, for garden planting the variety *P. avium plena* should be considered not only for its foliage but also for its marvellous spring display of flowers. A specimen of this may be seen in the Award of Garden Merit Collection, while near the Restaurant the leaves of *P. sargentii* will by early October have assumed a glowing crimson colour and with the arrival of the first frosts will soon fall.

The various autumn-colouring species of the genera *Cornus*, *Disanthus*, *Enkianthus*, *Ginkgo*, *Nyssa*, *Parrotia*, *Quercus*, *Rhus*, *Taxodium*, and *Vaccinium* were mentioned in the previous notes of October 1953.

PLANTS OF INTEREST AT WISLEY DURING OCTOBER

LABORATORY WALLS

Amaryllis belladonna
Ceratostigma plumbaginoides
Clerodendron bungei
Cotoneaster horizontalis

GLASSHOUSES

Abutilons in variety
Cassia corymbosa
Erica canaliculata
Fuchsias in variety
Leonotis leonurus
Luculia gratissima
Solanum jasminoides
Tibouchina semidecandra

WILD GARDEN

Acer griseum
Disanthus cercidifolia
Fothergilla species
Hamamelis japonica
Liquidamar styraciflua

FLORAL TRIAL GROUNDS

Trials of Dahlias
Trials of Early-flowering Chrysanthemums
Trials of Perennial Asters

BATTLESTON HILL

Acers in variety
Eucryphia glutinosa
Parrotia persica
Rhododendron luteum

SEVEN ACRES

Berberis in variety
Colchicums in variety
Cornus in variety
Hippophae rhamnoides
Malus in variety

WEATHER HILL

Cotoneasters in variety
Prunus in variety
Roses

AWARD OF GARDEN MERIT—LXXXIX

424 CHIONODOXA LUCILIAE

Award of Garden Merit, April 23, 1954

This charming little spring-flowering chionodoxa is a native of Crete and Asia Minor and is one of the most valuable and widely grown among the small bulbs, being aptly named "Glory of the Snow."

It was first introduced to cultivation by GEORGE MAW, the authority on crocuses, who found it on a mountain east of Smyrna in Asia Minor between 3,000 and 4,300 feet. He described it as follows: "Near the summit of the mountain a great mass of it was met with in full splendour, forming one of the most sumptuous displays of floral beauty I ever beheld; a mass of blue and white resembling *Nemophila insignis* in colour, but more intense and brilliant."

It flowers usually in late March or early April and the flowers are bright mauvish-blue as is shown by the coloured plate (Fig. 97) drawn by RAYMOND BOOTH. Towards the centre they fade to white and three to six flowers are generally borne on a scape about 6 inches in height. The leaves are lorate, bright green and shield the stem for some distance from the base. A white-flowered form is also known. *Chionodoxa*

luciliae has hybridized with *Scilla bifolia* to form the natural hybrid *Chionoscilla* × *allenii*.

The bulbs should be planted between August and November in a sunny position and then left undisturbed for several years. They are quite hardy and require no special soil conditions, except that they are unlikely to do well in a place that is waterlogged or badly drained. They can also be grown successfully in partial, but not in dense shade. They can be propagated easily from offsets which are freely produced from the bulbs. *Chionodoxa luciliae* may also be grown successfully as a pot plant for the decoration of the alpine house.

P. M. SYNGE

425 PHYSOSTEGIA VIRGINIANA 'VIVID'

Award of Garden Merit, September 22, 1954

Physostegia virginiana is a hardy herbaceous perennial which, as the specific name suggests, is a native of Virginia and other parts of North America, where it frequents the banks of streams and other moist habitats. This member of the Sage Family, the *Labiatae*, was in British cultivation as long ago as 1683, and is, of course, well known as The Obedient Plant for the reason that the flowers always stay in the position into which they may be pushed. It is a vigorous grower, spreading by means of white underground stems, forming large clumps and producing leafy flowering stems 3–5 feet high, in July, August and September. The leaves are lance-shaped or oblong-lance-shaped, 3–4 inches long, and sharply toothed, and the two-lipped rose-coloured inflated flowers are borne in large terminal spikes. Though it can be well grown in full sunlight, it does best in partial shade and is not fastidious as to soil conditions. This splendid border plant is subject to a great deal of variation, and from time to time several forms have been listed in horticultural literature; a giant form, with large deep-rose flowers, growing 6–7 feet tall; a dwarf form; forms with dense panicled spikes; a form with white flowers; and much the best, the form known as 'Vivid,' which has been in cultivation for over twenty years. How good a garden plant this has proved itself to be, is shown by the fact that not only did it receive the Award of Merit when exhibited by the late MR. AMOS PERRY, of Enfield, in 1931, but it was also given the same Award after trial at Wisley two years later. A compact plant, never growing more than 18 inches tall, of bushy habit and producing numerous spikes of brilliant rosy-crimson flowers, each flower an inch long and nearly half-an-inch wide, it is undoubtedly a most valuable addition to the front of the herbaceous border, or even to the rock garden. Division offers a ready means of propagation and planting is best done in October–November or in March–April (Fig. 105).

H. R. FLETCHER

MASTERS MEMORIAL LECTURE, 1955

LIGHT AND PLANT GROWTH

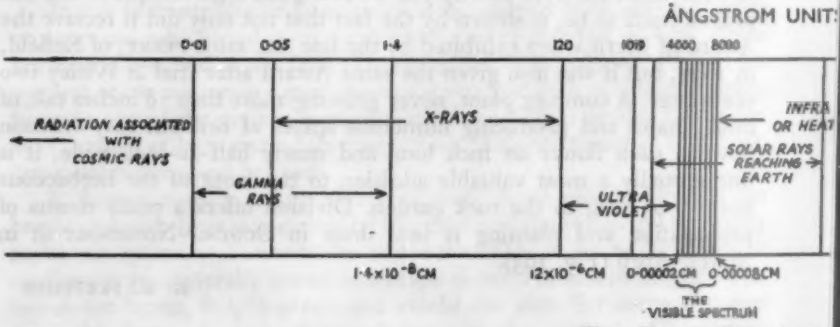
R. H. Stoughton, D.Sc., V.M.H.

(*Lecture given on April* 19, 1955; DR. H. V. TAYLOR, C.B.E., D.SC., V.M.H., *in the Chair*)

PART I

LIGHT is the dominant factor in the world of life as we know it. Our knowledge of the world is primarily dependent upon our sight, that is, upon the interpretation that our mental processes make of the physical image formed by light upon the retina of the eye. We can conceive of an existence in total darkness but we cannot imagine beings living in a darkened world attaining the mastery of nature which we have achieved through our sense of sight. However greatly the other senses may be developed, sight alone can give us that knowledge of things at a distance which is essential for scientific progress.

But light plays an even more vital role than that of enabling sight; it is the ultimate source of energy for life through the process of photosynthesis carried out by green plants, a process upon which, therefore, life itself, as we understand it, depends. All-important as photosynthesis is, however, it is by no means the only plant process in which light plays a part. Every one of the functions of the plant is influenced, directly or indirectly, by light; throughout the life-history of the plant, light is a cardinal modifying factor. Seed germination, leaf expansion, growth of stem and shoot, flowering and fruiting, dormancy and bud-break, all are influenced directly by light in one or more of its different aspects. It is my purpose in these lectures to give some brief account of these effects of light in plant growth and behaviour and to endeavour to assess their importance to the horticulturist and the ways in which further advances



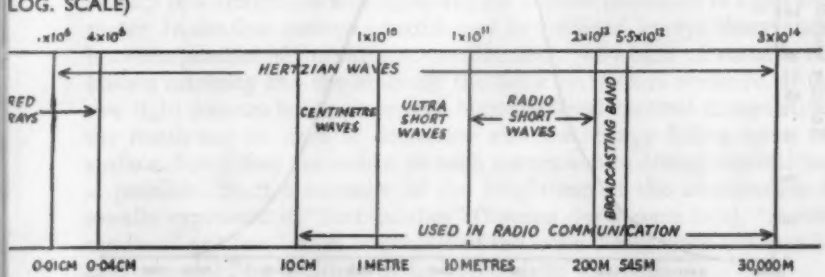
TEXT FIG. 1—The electro

in knowledge may lead us. It will be appreciated that in the time available it is possible only to select certain research results from the mass of data, but I have chosen these to illustrate what I think are some vital points in trying to understand the underlying principles.

DEFINITIONS

Before we can pass to the complex problems of the varying roles of light in the many phases of plant growth, we must have a clear understanding of the physical properties of the factor we are discussing and the terms we use in describing it. By "light" we usually mean that portion of the whole range of electromagnetic radiations which is capable of effecting a direct stimulation of the retina of the eye and so producing what we interpret as a visual impression. It has become common usage, however, to extend the range of this portion a little at either end and to speak of "ultra-violet light" and "infra-red light," in spite of the fact that radiations in both of these regions have no directly stimulating effect upon the retina and are, therefore, if I may use the paradox, "invisible light." The limits of these regions are ill-defined, principally for the very reason that we cannot see them. They have, however, as profound a biological effect in some respects as the visible radiation and must therefore be included in such a discussion as this.

In these days of radio and television the conception of wavelength is familiar to everyone and needs no explanation, but it is perhaps important to realize that in the enormous wavelength scale of electromagnetic radiation the visible region occupies only a minute part. It is, as it were, but one semitone in a piano keyboard many times longer than the usual eight octaves, a keyboard which extends from the bass of the long radio waves of over two thousand metres to the treble of the hard X-rays of one-thousand-millionth of a millimetre wavelength. Within this huge range the visible spectrum extends only from about four to seven ten-thousandths of a millimetre or, if we include the infra-red and ultra-violet, from about three to nine ten-thousandths. Yet, so far as we know at present, it is only this tiny fraction of the whole gamut



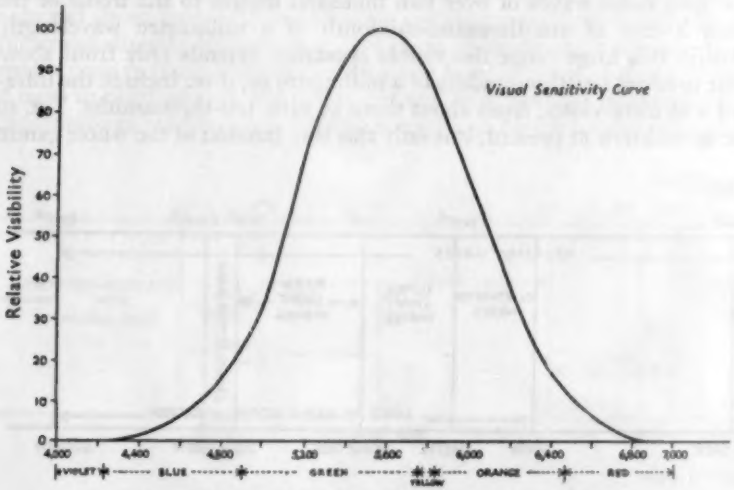
agnetic spectrum.

which is directly concerned in normal biological processes, though radiations outside this range may directly or indirectly modify these reactions. The range of the electromagnetic spectrum is shown in Fig. 1. It is necessary to represent this on a logarithmic scale as otherwise the length would be many feet.

The customary units of measurement for wavelength of light are either the millimicron, which is one-millionth of a millimetre, or the Ångström unit, which is one-tenth of a millimicron. For convenience in speaking and in subsequent printing I shall use the Ångström unit throughout this lecture. The different colours of the spectrum occupy the ranges shown in Text Fig. 1, although it must be remembered that there are no sharp dividing lines and that the colour gradation is continuous.

Now light, as with all radiation, is a form of energy and it is by virtue of this energy that it produces its diverse effects, basically, it is believed, through photochemical reactions. The retina of the human eye is most strongly stimulated by the energy of light in the green region of the spectrum, at a wavelength of about 5200 Å. To produce a stimulus equal to that of a given green light, that is, to seem equally bright, red or blue light must have greater energy. The relation between the wavelength of light and the stimulus produced in the eye is shown in Text Fig. 2 and is known as the visual sensitivity curve. From this we can see that if a red and a green light have about the same apparent brightness as, for instance, in the ordinary street traffic lights, there is far more energy in the red light than in the green.

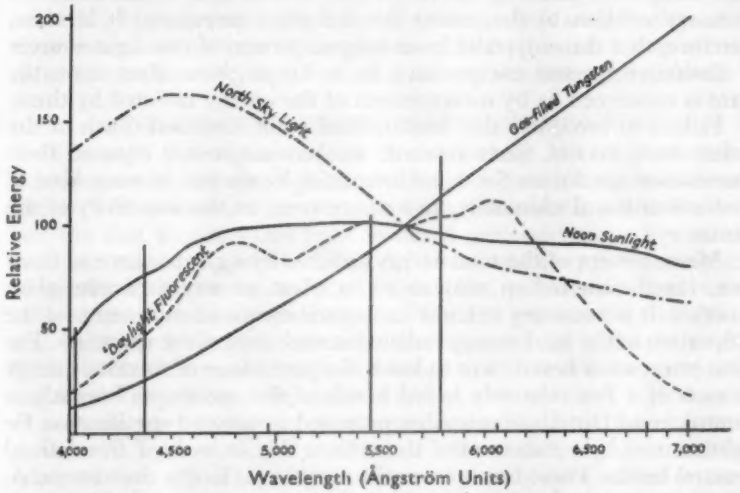
Now, all this has a very important bearing on the measurement of light and therefore upon experimental studies on the effect of light on plant growth, since no two kinds of artificial light have the same



TEXT FIG. 2—Wavelength in Ångström units.

spectral composition and even daylight is far from constant in its composition. North sky light possesses a much greater proportion of the short, or blue, wavelengths than sunlight, and the light of the early morning or the evening sun differs in composition from sunlight at noon. If we are interested in the effects upon plants of different portions of the spectrum the importance of the facts which have been outlined becomes even greater. Text Fig. 3 shows the spectral distribution of energy for a number of familiar light sources.

We may determine the quantity of light incident on a given plane in one of two main ways. We may measure its intensity by the brightness of a white surface illuminated by it or we may measure the amount of



TEXT FIG. 3—Spectral energy distribution of some common light sources. (Line spectrum = High-pressure mercury vapour lamp).

energy falling upon unit area by absorbing the energy on the totally black surface of a thermopile and observing the current produced in a galvanometer. In the first method a match may be obtained, by eye observation, between patches of the surface, one illuminated by light of variable but known intensity and the other by the light we wish to measure. If the two light sources being compared have identical spectral compositions the result can be used to determine also the energy falling upon the surface, but if they are unlike no such conversion to energy equivalence is possible. Such a measure of the brightness of the illumination is usually expressed in "foot-candles" (lumens per square foot), "metre-candles," or "lux," units which are of the same dimensions and may be interconverted by multiplying by appropriate constants.

A less subjective method of measuring brightness of illumination is by the use of a "barrier-layer" type of photo-cell, an instrument which

produces a current which is a function of the intensity of the illumination falling upon it. The sensitivity of the photo-cell, however, like that of the human eye, is not constant for all wavelengths and thus the same difficulties arise in its use for comparing light from different sources. The black surface of a thermopile, however, absorbs light of all wavelengths equally (including ultra-violet and infra-red) and thus gives a true measure of the total energy falling upon it.

Now, the photochemical reactions of the plant are affected to varying degrees by different regions of the spectrum and the different reactions themselves do not have the same relations to wavelength. Measurements of light intensity by determination of brightness involves, as we have seen, the sensitivity curve for the human eye, which bears no necessary relation to the curves for the plant responses. It is clear, therefore, that the only valid basis for comparison of two light sources of dissimilar spectral composition; in so far as their effect upon the plant is concerned, is by measurement of the energy radiated by them.

Failure to recognize this fundamental point rendered much of the earlier work invalid, since research workers commonly equated their illumination conditions for equal intensities by the use of some kind of photometer based ultimately, as we have seen, on the sensitivity of the human eye.

Measurement of the total energy radiated by a given source is, however, insufficient for an analysis of its effect on any particular plant function. It is necessary to know its spectral composition in terms of the proportion of the total energy radiated in each part of the spectrum. For most purposes it is sufficient to know the percentage of the total energy in each of a few relatively broad bands of the spectrum. Recently, a committee of Dutch scientists has proposed a standard specification for light sources by a statement of the radiant flux in each of five defined spectral bands. These bands cover the ranges: (1) longer than 10,000 Å, (2) 10,000 to 7,200 Å, (3) 7,200 to 6,100 Å, (4) 6,100 to 5,000 Å, (5) 5,000 to 4,000 Å. Determination of these figures can be made either by direct measurement of the energy in each band by the use of suitable light-filters or by calculation from the lamp manufacturers' spectral distribution curves. The adoption of these specifications in future use would help greatly in comparison of different workers' results.

Since much of what I shall have to say about the influence of light upon growth processes will involve the problem of light quality, this somewhat lengthy physical explanation is not irrelevant.

It is not, however, sufficient to characterize the light factor by its energy distribution and intensity only. A third aspect of equal or, often, of even greater importance is the duration of the light, especially the duration in relation to the length of any corresponding dark period. In some plant functions, as for instance photosynthesis, the amount of the response is, broadly, proportional to the total quantity of light received, that is, the intensity multiplied by the duration. Thus, within certain limits, twice a given intensity of light acting for half a given time will

produce the same effect, say amount of sugar synthesized, as half the intensity for twice the time. But in other plant responses, notably in the induction of flowering, this relation no longer holds and, again within certain limits, different durations of illumination will produce entirely different effects independently of the intensity.

In any experiments involving light, therefore, it is important that we should know three things about the light factor: (a) its intensity in terms of energy, (b) its spectral composition, and (c) its duration or "photoperiod," including the duration of the associated dark period, if any. If any of these factors are unknown, not only may we draw unsafe conclusions from the results, but it is impossible to compare results from different experiments or from different workers. In my discussion of the role of light in the various phases of plant growth and development I shall endeavour to show the separate and inter-related effects of these three factors, intensity, quality and duration wherever appropriate.

INFLUENCE OF LIGHT ON SEED GERMINATION

The early investigators of the late eighteenth and early nineteenth centuries concluded that light was either detrimental to germination or had no effect. CASPARY in 1860, studying the aquatic plant *Bulliarda* was the first to claim that light favoured germination, and PEYRITSCH and WIESNER in 1879 showed that light was necessary for germination of mistletoe, *Viscum album*. STEBLER, in 1881, published a work on the subject, in which he reported experiments with grass seeds, and claimed that light was favourable to many species, especially in the genus *Poa*. With *P. nemoralis* under controlled temperature conditions germination was from 1 to 3 per cent. in darkness and 53 to 62 per cent. in light, while *P. pratensis* gave 0 to 7 per cent. germination in the dark and 59 to 61 per cent. in light. STEBLER's results were later confirmed and extended by other workers who showed that while many seeds were indeed favoured by light under certain conditions, environmental and internal factors could modify or even reverse the effect. Such factors as maturity or age of the seed, the condition of the seed-coat, oxygen pressure, temperature, acidity and the presence of nitrates, among others, could profoundly alter the reaction to light. Because of these interactions, the literature on the favourable effects of light is confusing, since many workers, failing to realize the importance of these modifying factors, did not state the conditions of their experiments with sufficient accuracy.

While light favours or is even necessary to the germination of some seeds, with others the reverse is true and light reduces or inhibits activity. A classic example, which will be referred to in more detail later, is provided by *Phacelia tanacetifolia*, which was first shown by REMER in 1904 to be markedly reduced in germination by quite weak diffused light. KINZEL studied the seeds or fruits of 964 species at temperatures around 65° F. and found that about 70 per cent. were light-favoured, 26·5 per cent. dark-favoured and 3·5 per cent. indifferent.

SEEDS THAT ARE FAVOURED BY LIGHT

Outstanding among the families of plants, the seeds of which are favoured in germination by light, is the family Loranthaceae. *Viscum album* has been the species most studied, but *Loranthus* and *Arceuthobium* have been shown to have similar requirements.

WIESNER, working in Vienna during the months of March and April, found that the germination of mistletoe seeds increased with increasing light intensity. A minimum of 4 per cent. of full sunlight was necessary for germination to occur at all and the percentage germination rose to a maximum at about halfnoon sunlight. In continuous darkness seeds died in a few weeks. These seeds are surrounded by mucilage, and will not usually germinate in the presence of water. In nature, a six-month rest period is usually necessary before the seeds will germinate, but WIESNER showed that by providing optimum conditions of about 65° F., good light and dry air, the period could be reduced to about one month. HEIMICHER later confirmed WIESNER's observations in general but added the interesting point that red and orange light was effective in stimulating germination, while blue light had no effect. He also worked with *Arceuthobium* and showed that not only was light necessary for its germination but that a cellulose substrate such as filter-paper or wood was also necessary. This he interpreted as showing that *Arceuthobium* was more strictly parasitic than *Viscum*.

The seed of the Mexican pampas grass, *Chloris ciliata*, was intensively studied by GASSNER. The achenes of this plant after-ripen slowly in dry storage, the process being complete in about eight months. GASSNER showed that non-after-ripened achenes in their hulls required light for germination at temperatures above 70° F. (optimum 92° F.) but that at lower temperatures light reduced germination. Fully after-ripened achenes still germinated much better in the light but gave about 16 per cent. germination in darkness. Removal of the hulls or increase in oxygen pressure resulted in more or less complete germination in light or darkness. The achenes with hulls intact were very sensitive to darkness and a period of a few days in a dark germinator at the optimum temperature resulted in the achenes becoming "dunkelhart" or "dark hardened", so that they would not germinate subsequently even in the light. GASSNER concluded that failure to germinate of achenes with intact hulls was due to insufficient entry of oxygen to the embryo and that light acted in some way to increase the permeability to oxygen, though he did not investigate the seed coat or hull structure directly. He later showed that the presence of nitrates increased germination in the dark, even though the nitrate ion apparently failed to enter the seed. This could not be due to any oxidizing effect since other soluble nitrogen compounds, such as ammonium salts and urea, were also effective. GASSNER believed that the presence of nitrogenous substances in the soil accounted for the much better germination in soil than in a germinator.

Species of *Poa* illustrate also the extent to which other conditions may modify the response of seeds to light and darkness. Most workers,

since the early reports of WAGNER in 1878, have found that the seeds of *Poa* are light-favoured, but results have been conflicting because of the failure to realize this modifying influence of other factors. JÖNSSON, however, showed that the need for light for germination fell as the seeds after-ripened in dry storage. Thus, fresh seed of *P. pratensis* failed almost entirely to germinate in the dark, but during a year of storage the percentage germination at 68° F. in the dark rose steadily until it was equally good in light or darkness. Later workers showed that the hulls played some part in sensitivity to light but that this was much less marked than in *Chloris*. As with the latter genus the presence of nitrates markedly increased germination in the dark, but increased oxygen pressure had no effect. Several workers, including GASSNER, have shown that intermittent temperatures greatly favour germination of *Poa*, sometimes even exceeding the effect of light. Usually a long period, say eighteen hours, at the low temperature (68° F.) and a short period of six hours at the higher temperature (85° F.) is most effective.

As with *Chloris* the longer wavelengths of light are most effective, the blue end of the spectrum being very unfavourable, but this response may again be modified by temperature, and with the most favourable alternation of temperatures wavelength has little effect.

Many other grasses have been studied, though less intensively than *Poa*, and with the exception of the cultivated cereals, which are indifferent to light, most have been found to be light favoured under certain conditions.

Of greater interest to the horticulturist is the behaviour of certain alpines. Seeds of *Ramonda pyrenaica* and *Primula obconica* have a marked light requirement, and those of *Gentiana lagodechiana*, *Primula denticulata*, *Draba aizoides*, and *Mimulus langsdorfii*, while capable of germination in the dark, are light-favoured and at certain temperatures are largely inhibited by darkness. Species of *Oenothera* and *Lactuca* behave like *Chloris* and require light for germination when freshly harvested but become indifferent after prolonged storage.

SEEDS THAT ARE INHIBITED BY LIGHT

The two plants in this group which have received most attention are *Phacelia tanacetifolia* and *Nigella damascena*. All workers agree that the germination of *P. tanacetifolia* is greatly hindered by light, the inhibition increasing with light intensity. Freshly-harvested seeds are, as with the light-favoured seeds, more sensitive than those which have been dry-stored for long periods, and the inhibition is greatest at temperatures below 50° F. At 60° F. some germination occurs even in strong light. Several workers have found that increased oxygen pressure improves germination in the light and that removal of the seed-coat usually permits germination even in fairly strong light, suggesting again that it is the testa or enclosing structures in some cases which is concerned in the light-response.

KINZEL showed that at high temperatures seeds of *Nigella* were rendered "light-hard" by exposure to strong light and were then incapable of germination without special treatment. At temperatures below about 60° F. the seeds did not become "light-hard" but were still much reduced in germination by light.

As mentioned earlier, KINZEL claimed that the seeds of many other plants, especially in the Liliaceae, were dark-favoured, but as the interrelations with temperature were not studied little account can be taken of these reports.

It is clear that the light response of seeds is a complex problem and that far more study is required. In the present state of knowledge, the mechanism of the response is obscure. Many suggestions have been made as to the way in which light operates but they rest on such conflicting evidence that little would be gained by discussion of them. The greater part of the work was carried out before the role of growth-substances in plants was realized and it may well be that an attack on the problem from this angle would yield fruitful results.

INFLUENCE OF LIGHT ON GROWTH

The primary phenomenon shown by living things is growth. While growth may from one point of view be looked upon as the integrated result of all the innumerable functions and reactions of the protoplasm yet it is at the same time a single function of the organism, the essential function which differentiates living from non-living and whose ultimate nature still eludes us. As a single function we can determine its progress by appropriate measurements and thus investigate the effect of changing the environment in which it occurs. Here we are concerned only with the effect of one environmental factor, light, upon growth considered as a function.

Light has a profound effect upon growth whether judged from the standpoint of amount or rate of growth, form or structure of the organism, or differentiation of tissues. Let us consider first the effect of light upon elongation growth. A seed germinating in total darkness produces a shoot which, if conditions of temperature and moisture are favourable, elongates at a rapid rate. This rapid elongation enables a seedling, emerging from a seed below the surface of the soil, to push quickly up towards the light and air. Immediately upon reaching the surface the rate of growth slows markedly until photosynthesis begins. Light checks elongation growth of the stem, roughly in proportion to the intensity of the light. Potatoes sprouted in the dark produce long, spindling shoots, in the light the shoots are very short and stubby. Absence of light results not only in a greater rate of elongation but in structural differences in comparison with plants grown in normal illumination. The stems of seedlings in total darkness are smaller in diameter, are characteristically hooked at the apex, show less development of vascular tissue and have thinner cell-walls. Leaf development is inhibited and leaves are reduced to small scales, closely appressed to the

stem. This distinctive development of plants in complete absence of light, called *etiolation*, is not due to the inability to synthesize food material, since it is shown by shoots developing from tubers, such as the potato, in which there is a plentiful supply of reserve food. Very brief exposures to light, insufficient to allow of chlorophyll formation, bring about marked changes in completely etiolated plants; the "plumular hook" disappears, elongation growth is reduced, and considerable leaf expansion is shown. Longer exposure to even low intensity light permits of synthesis of chlorophyll, still further reduction in internode length and greater leaf expansion.

The inhibiting effect of light on elongation growth was without explanation until the recognition in the third decade of this century of the existence and role of growth hormones in plants. The experiments of PÀAL, BOYSEN-JENSEN and WENT showed that cell elongation was made possible by the action of a hormone or growth substance, which is produced in the growing apex and conveyed to the zone of elongation, and which affects the plastic properties of the cell-wall. In the absence of growth hormone the cell-wall is incapable of stretching under the turgor pressure within it resulting from water intake, but a supply of hormone causes the wall to "give" without breaking so that the cell can elongate. If the apex of the shoot is illuminated, under normal circumstances less growth substance reaches the zone of elongation so that the rate of growth in length is reduced.

The exact mechanism by which light produces this effect is not yet fully understood; one or both of two explanations may be possible. Light may cause a lesser production of growth-substance from its precursor or it may cause a destruction of the substance after it is formed. There is much evidence to show that the latter is true in some instances at least.

This effect of light upon the growth hormone of plants is the explanation for the phenomenon of phototropism or the bending of shoots towards light coming from one side. Under unilateral illumination the production and transport of hormone on the lighted side is reduced or inhibited in comparison with the shaded side, so that elongation on the illuminated side is reduced. The more rapid growth of the shaded side causes an apparent bending of the stem towards the light. It is clear that the phenomenon of phototropism can only be exhibited by an actively elongating stem. In the root the effect is opposite in nature since reduction of hormone allows of more rapid elongation so that the root, if it reacts at all to unilateral illumination, usually shows negative phototropism in contrast to the positive phototropism of the shoot.

Through its effect on elongation growth, light intensity may profoundly modify the growth-form or habit of the plant. Everyone is familiar with the fact that a plant grown in a shady position is taller and more spindly than one grown in full sunlight. An extreme example is provided by the behaviour of certain alpine plants which, grown in the

high light intensities of great altitudes, have a rosette habit of growth with sessile flowers, but which, grown in the lower intensities of the valleys, produce elongated stems and stalked flowers.

Elongation growth is not, however, the only aspect of growth or even the most important. Total size of plant and ultimate yield are determined by the rate of accumulation of dry matter as a result of photosynthesis and this in turn is determined by leaf area, photosynthetic efficiency and light energy availability. The precise relations between light energy and rate of growth as measured by increase in dry weight and total leaf area have been the subject of much study of late years, more especially in this country by GREGORY and by BLACKMAN. The approach to an understanding of these fundamental relationships by the method of growth analysis has become one of the most fruitful lines of advance in plant physiology. It is again necessary to define certain terms in common use in this kind of study. "Relative growth rate" is defined as the overall increase in dry weight per day expressed as a fraction of the mean total plant weight. "Net assimilation rate" is the increase in dry weight of the plant per week for each 100 square centimetres of leaf area. "Leaf area ratio" may conveniently be defined as the ratio of total leaf area to total plant weight and is a measure of "leafiness." It may be shown mathematically that the product of the net assimilation rate and the leaf area ratio is equal to the relative growth rate, or in symbols

$$\text{N.A.R.} \times \text{L.A.R.} = \text{R.G.R.}$$

BLACKMAN has determined these values for a range of native and cultivated plants under different light intensities (produced by shading) and at different seasons of the year. His conclusions, which were often quite unexpected, may be briefly summarized. For all species examined, even such a shade plant as *Geum urbanum*, the net assimilation rate is highest in full daylight and decreases logarithmically as the light level is reduced to one-tenth of daylight. Leaf area ratio, however, shows precisely the opposite relationship to light intensity, and within the same range the rate of increase of the ratio with decreasing light level is approximately logarithmic.

Since the relative growth rate is the product of the net assimilation rate and the leaf area ratio and these two measures are linear functions of the logarithm of the light intensity, the relation of relative growth rate to the latter will be curvilinear, the shape of the curve varying with the species. The light intensity at which growth rate will be at a maximum can be calculated from the linear functions and BLACKMAN found that for the shade plants this optimum is at about half full daylight, while for sun plants such as clover and medick it is one and a half to twice full daylight. This means that such plants could increase in dry weight more rapidly than they do in full summer sunlight if more light were available. Between these two extremes there is a broad group of species which grow best at levels a little below full daylight.

Analysis of the relative growth rate into the separate parts, root, stem and leaves, shows that shading decreases root growth, increases the proportion of stem and has little effect on the leaf weight. The ratio of leaf area to leaf weight, therefore, increases markedly with reduction in light intensity in all species.

Studying the seasonal changes, BLACKMAN found that net assimilation rate is closely related to the logarithm of the diurnal light energy, independently of temperature. The leaf area ratio, however, while decreasing with rising light energy, increases with temperature, with the result that relative growth rate is also positively correlated with temperature and light intensity.

The implications of BLACKMAN'S results to the horticulturist are particularly important in glasshouse cultivation. LAWRENCE has shown that the average light intensity in a glasshouse is rarely more than 75 per cent. of outside daylight and more often nearer 50 per cent., so that it is below the optimum for relative growth rate for many plants at any time of the year. The practice of shading must be expected to reduce net assimilation rate to a point where relative growth rate will be seriously affected even in summer. The higher temperature within the glasshouse will, it is true, increase the leaf area ratio and this compensating effect is especially important in winter, but it remains true that light intensity is too low for optimum growth rate.

Increased leafiness in the conditions of low light intensity and high temperature may be valuable in some crops, such as lettuce, but it must be remembered that at the same time root growth is reduced and the proportion of stem increased, which may be undesirable. Since varieties differ in their response to light and temperature conditions it is clear that selection of suitable varieties by this kind of analytical approach is of great importance in the drive towards greater productivity.

So far we have been concerned with the relationships of daylight or, substantially, white light to growth. For the reasons explained earlier, it is necessary to know also the effect of different wavelengths or regions of the spectrum on the growth of plants. This has been a subject of study since the work of SCHANZ in 1919 and that of POPP some years later. Most of this earlier work was carried out with daylight filtered through coloured glass or gelatine screens and was open to three objections. First, no practicable filters exist which will pass only a restricted band of wavelengths in the shorter wavelengths regions of the spectrum. It is possible to use a filter which passes only the red light of the visible region, though this will also transmit the infra-red, but no filter of sufficiently high total transmission can be found which transmits the blue without any red or green. Secondly, in much of the earlier work the different coloured lights were equated for equal intensities and not for equal energies with consequences explained earlier in this lecture. Thirdly, in few cases were any precise specifications of the light quality or quantity given. Since some plants respond differently at different intensity levels of the same wavelength band, comparison between

various workers' results is impossible. Later workers have given more exact information, and a body of evidence is being collected. In general, two lines of approach have been made to the problem. On the one hand, some investigators have worked with light of high spectral purity from monochromators. This entails using very small numbers of plants or seedlings, since the area which can be illuminated with a given band is small. On the other hand, much work has been done with artificial light sources of restricted spectral output combined with filters or other means to produce wider bands of higher intensity over a greater area.

At Reading University, we have recently constructed illumination chambers provided with frameworks carrying fluorescent tubes of different spectral output suitably filtered to give three different wavelength bands, 3000–5000 Ångström units, 5000–6000 Å and 6000–7000 Å. The tubes are arranged in such a manner that a volume about 5 feet by 6 feet by 2 feet is reasonably uniformly filled with light, so that the plants are exposed to approximately constant irradiation as they grow and, in addition, receive light from the sides as well as from above. Equality of light energy in the chambers is attained by varying the number of tubes in the frameworks. With the latest type of tube and filter it is possible to obtain a mean irradiation intensity of about 7500 ergs/cm^2/sec. which, in the case of the white light control, corresponds to an illumination intensity of about 200 lumens per square foot.

Using these chambers, VINCE has studied the response of pea and tomato to the different wavebands. These plants were chosen because they have been widely used by other workers and results have been conflicting. Further, they represent two opposite types of seedling, that with a reserve of food material upon which to draw and that without. VINCE found that with tomato total stem length, internode length and leaf length increased with increase in wavelength, whereas with pea (var. 'Meteor') total stem length and internode length decreased, though length of leaflet increased, under the same conditions. With 'Alaska' pea there was little difference in any wavelength region. It is probable that the response of tomato is the more usual. Light quality also affected the form of growth, wavelengths greater than 5000 Å (i.e. the red and orange region) caused epinasty or downward rolling of the leaves, while in blue light the leaf blades were flat. These responses are characteristic of plant hormones and a study is now being made of natural auxin concentrations and gradients in the plants grown in the different chambers. More detailed growth analyses of the same kind as those of BLACKMAN in daylight are also being pursued on these plants.

As I have suggested earlier, growth analysis studies of this nature will lay the foundations for a proper understanding of the physiological effects of light upon growth of plants and are essential for an approach to the even more complex problem of light in relation to plant development.

Finally, in this section, we must turn briefly to the influence of duration of light on growth rate and amount of growth. Most studies on photoperiodism have been concerned chiefly with the relation of day-

FIG. 97—*Chionodoxa luciliae*, which recently received an Award of Garden Merit. From a painting especially made by MR. RAYMOND BOOTH (See p. 452)

Photo, Frances Perry

BOG AND MOISTURE-LOVING PLANTS

FIG. 98—*Lysichitum americanum*, a suitable plant for the bog garden

(See p. 473)

Photo, Frances Perry

FIG. 99—*Calla palustris*, the bog arum (See p. 473)

Photo, W. Abbing

MODERN CARNATIONS AND PINKS

FIG. 100—Perpetual Flowering Pinks, illustrating free flowering. The variety is 'Constance'

(See p 479)

Photo, W. Abbing

FIG. 101—Dianthus 'Delight' being grown for seed crop
(See p. 481)

Photos, Allwood Bros. Ltd.

FIG. 102—The modern laced Pinks showing varying ground colours and lacings (See p. 479)

FIG. 103—Selection of modern varieties of Perpetual Flowering Carnations

Photos, J. E. Downward

FIG. 104—*Magnolia* × *loebneri* 'Leonard Messel' (*M. kobus* × *M. stellata rosea*). **A.M.** May 3, 1955, shown by MRS. L. C. R. MESSEL and The National Trust (See p. 484)

FIG. 105—*Physostegia virginiana* 'Vivid,' which recently received an Award of Garden Merit (See p. 453)

Photo, J. E. Downward

FIG. 106—*Gladiolus* 'Atlantic' the best spike in the R.H.S. Gladiolus Competitions, held on August 9. Exhibited by W. S. DWYER, ESQ.

length to flowering in plants, but the daily period of illumination may in some cases profoundly modify vegetative growth. Primarily, the amount of light received by the plant will determine the rate of increase in dry weight, as we have already seen in the discussion of growth analysis. One would expect, therefore, that the longer the day the greater will be the amount of total growth and *vice versa*. Usually this is true but in certain cases a very striking deviation from proportionality is found. One very remarkable example has been found recently in some new work at Reading on the effect of daylength on the growth of fruit trees. Blackcurrants exposed to a constant daylength of 13½ hours make normal growth and with 17 hours make, as expected, rather more; but if they are given only 8 hours of daylight in each 24 hours, growth is completely suppressed. The plant does not die but passes into a condition of quiescence and can resume growth immediately it is transferred to long days. Many plants show reduced growth and change of form under these short days but this is one of the few cases I know of where growth is entirely inhibited. Much further work is needed to determine the critical daylength and the mechanism of this effect, but its implications may be far-reaching. The limitations placed on flowering and fruiting of many temperate plants by the short days of equatorial latitudes, which will be discussed later, are well recognized, but it may be that the influence of this factor on vegetative growth is also of considerable importance.

(*To be concluded*)

BOG AND MOISTURE-LOVING PLANTS

Frances Perry

(*Lecture given on June* 28, 1955, DR. H. V. TAYLOR, C.B.E., V.M.H., *in the Chair*)

Bog gardening naturally follows in the wake of water gardening, but it is no more necessary to have a pool before growing such plants than it is wise to assume that aquatics are an essential adjunct of marsh flora. Nevertheless, it must be admitted that the two used in conjunction give more natural effects and often afford an attractive combination of different plant types.

In bog gardening we deal with subjects which require constant dampness at the roots and yet are neither immersed nor floating. Instead they grow freely above the soil.

Individual requirements often show considerable divergence. Some prefer a site well open to the sunshine but with the ground so damp as to be in a perpetually sodden state. This same situation would be intolerable to others, however, and many species, whilst intolerant of

drought during the summer months, cannot live with the roots actually *standing in* water.

Naturally bogs can be of various kinds. The most generally accepted interpretation of the word conjures up pictures of a quaking, squelching morass, so soft underfoot as to make walking hazardous, and with quantities of bright sphagnum moss interspersed with cotton grasses, and various heaths. This is a peat bog, made up of varying depths of the material (mostly of moss origin), which has not rotted down in the usual way through bacterial activity, because the ground is too waterlogged to allow of their natural functioning. The aerobic bacteria, which under normal conditions effect the rotting down of vegetation, must have oxygen, moisture and a reasonable degree of warmth, but, in a waterlogged soil all the available air spaces are filled with moisture and the first essential is in short supply. And so, the vegetation instead of being reduced tends to build up, ultimately becoming the material we know as peat. This generally has an acid reaction, a factor which often determines the type of plants it can support. Very occasionally, however, peat may accumulate over limestone, and then one finds a limestone rather than an acid flora.

There are also peat deposits which have been made up not of ericaceous plants and mosses, but of sedges, and other characteristic plants which favour alkaline conditions. This change in vegetation comes about because the water derives from surrounding limestone rock and soil areas. The National Trust property at Wicken Fen is typical of this type, and with its wide range of plant material affords a rich study for botanists.

It is, however, possible to get boggy areas where no peat formation exists at all, and where, indeed, the soil is naturally well drained or of a mineral nature. This naturally occurs round the margins of existing waterways—in streamside meadows subject to periodic floodings, low depressions near ponds or on slopes where springs or streams arise. This is the condition many find naturally in their gardens and it also represents the type most easily copied by man.

Such a bog, or maybe marsh is the better word, can be a nuisance or asset according to the way one approaches the problem. Bad drainage or constant moisture may put the area out of bounds for normal gardening (unless one resorts to a proper drainage system), but, on the credit side, it does afford the gardener opportunity for growing some very beautiful and interesting plants which would not flourish elsewhere in the garden. Such a feature, when found naturally, should be looked upon as a challenge and an opportunity; an established bog garden is usually labour saving and can afford rare glimpses of beauty in the happy dispositions of its exotic-looking flora.

And that is the keynote and secret of such plantings—naturalness. Let the scheme be artistry, with informality: for the art of bog gardening lies in colonizing plants and suiting individuals with their own particular requirements. It is the failure to understand this and to realize

that bog plants cannot be lumped together indiscriminately that leads to so many disappointments. An intimate knowledge of the individual is necessary before it is allocated a permanent position in the bog garden.

Many gardeners have no conception of the beauties of marsh flora and so pass over numbers of charming plants, natives to northern and temperate regions, whose home is in the lush richness of the open marsh or bog. In such spots, when they are really happy, we find areas where plants set their own seed, hybridize between species if they will and so set up natural colonies which become the joy of the owner and the delight of visitors.

THE NATURAL BOG GARDEN

When taking over an existing piece of swampy land for a bog garden, one of the first tasks will lie in eradicating thoroughly, roots as well, all the natural crop of water-loving subjects that are already established. This *must* be done or any plants introduced later will never be able to compete with their firmly entrenched roots and strangling top growth. The clearance should be extended a foot or more beyond the confines of the swamp, for rushes and sedges are particularly invasive and have probably established footholds well beyond the apparent margins.

If the water is too deep it may be necessary to cut trenches to enable it to run from the surface areas. This will certainly make the task of root eradication easier, and enable one to work in comfort when providing soil for planting purposes. Since some moisture-loving subjects like water round their roots and others abhor it, it follows that undulating levels, or raised mounds built above the swampy areas, will provide the answer to most planting problems. An example of the varieties desired, one may wish to grow primulas and calthas. The latter revel in wet mud or even shallow water, but primulas belong to that class of plant which likes circulating moisture *below* the surface, with the top soil comparatively dry. One should, therefore, plant the calthas in the wettest position but assign the primulas to the raised mound or any sloping ground just above the bog margin.

A good soil for the cultivation of bog plants is a light rich loam which is well manured. This is particularly so for those which like to feel the influence of water rather than its presence—like *Iris sibirica*, primulas and some gentians and bulbous subjects. It drains easily from the top but moves freely just below the roots. Other plants will need stiffer composts, and peat and leaf-soil or other materials can be incorporated according to individual requirements.

When dealing with natural swamp-land, standing moisture is likely to be augmented at times by drainage water from surrounding land. When the area is extensive enough to make walking at these periods messy or hazardous, stepping stones of irregular design can be set in the wetter parts. By this means nearby plants can be viewed and tended without inconvenience.

ARTIFICIAL BOG GARDENS

In the smaller garden or where low-lying boggy areas do not naturally exist, provision must be made artificially for the growing of moisture-loving plants. Whilst such a feature is usually built in the vicinity of water, as near a stream or pool, it is not essential that it should be linked with a water garden. Any low-lying area that receives a fair amount of water after rain can readily be kept permanently moist with a little assistance from a hose or piped supply.

If wastage is severe the moisture can be trapped by excavating some of the soil, 12–15 inches deep, and making a basin of brick or concrete. Drainage holes should be left at intervals round the sides (say every 3 feet apart and 6 inches down from the surface) to carry away excess moisture. If the disposition of plants is to be more aquatic than bog, these can be reduced or dispensed with entirely, but when subsoil water only is needed it pays the gardener to provide safeguards against flooding. It is a wise provision, therefore, also to cover the base with 5 or 6 inches of crushed brick, slag or any such hard-core, and, over this, place 12 or 18 inches of loam.

Bog plants generally favour a rich soil, so that *well*-decayed manure, leaf-mould or peat can be incorporated with the compost. Lime should only be added to suit individual requirements.

Lay out the area in easy informality. Undulating ground always looks more attractive than flat, and the combination of better drained and swampy areas allows for the cultivation of varying plant types.

As long as water lies just under the soil it will remain in a perpetual state of dampness. But, when this fails (as it may well do in a very hot dry season), the supply must be maintained by the slow trickle from a hidden tap or hose, or failing this, by replacement with a can. Incidentally, plastic hose, perforated every 6 or 9 inches, and laid on top or just below soil level is invaluable in the bog garden as it quickly soaks the area in a very uniform manner.

PLANTS FOR THE BOG AND WATERSIDE

Of plants for the bog garden there are enough and to spare: scrambling, rambling, rampageous kinds that are best debarred altogether—lest the entire area succumbs to their stranglehold in a year or so; choice, bright-coloured beauties that can only be seen to perfection in those regions where parched thirst is unknown, and bizarre plant curiosities which seek bog conditions simply because it provides them with necessities and opportunities they seek in vain elsewhere.

But first, because light and shade areas will both be needed, start by planting the woody subjects—the shrubs and small trees. FARRER once remarked that the supreme test of the gardener's craft lay in the placing of his shrubs, and one must be careful not to overdo or use wrong material for this feature. Fortunately, there are many from which to choose, deciduous and evergreen, large and small. If conifers are

desired why not try some of the deciduous forms like *Taxodium distichum* or the recently discovered, strangely beautiful *Metasequoia glyptostroboides*. The latter is a real fossil tree, for it flourished millions of years ago, and geologists find plentiful evidence of its fossil remains as far back as the Mesozoic period. In 1946 a few trees were discovered in China and from this source seed has been widely distributed. And so today we have a new tree for our gardens; one which is not only hardy, and attractive in spring with its pale lacy foliage, but also singularly fine when the fingers of autumn reach into the garden and turn the leaves to a rich foxy red. It is an interesting plant, moreover, to own, on account of this strangely romantic history.

And for ordinary deciduous trees we may have small weeping willows and silver birches which look happily at home in even the smallest garden. Rhododendrons, kalmias, sweet-scented *Myrica gale* or the andromedas all like a fair amount of moisture, and on the better-drained slopes provision could be made for some of the hardy bamboos.

Among the more spectacular plants for the raised areas of the bog garden, astilbes, trolliuses, primulas and irises will provide bold splashes of colour in early summer. Only in the constant cool moisture of the waterside are *Primula japonica*, *P. pulverulenta* and *P. sikkimensis* seen to perfection, but then they send up fat stems crowned with tier on tier of bells, so brilliant in colour that the whole area looks like a vivid patchwork quilt. Prepare the soil well for primulas. They are the rent-payers of the bog garden and, providing the soil never dries out, soon form broad colonies, dropping their seed and spreading naturally without aid from the gardener.

Astilbes and *Iris sibirica* are other bright beauties which give little trouble. The colours of the former range through pure white and cream to pink and red, whilst good varieties of *I. sibirica* worth noting are 'Emperor,' 'Marcus' and 'Snow Queen.'

A well-grown lily is a queen amongst plants and many members of this noble genus favour the shelter of undergrowth and are almost bog plants in their requirements. The conditions they need are rich, well-drained soil on mounds or slopes above water, so that the latter keeps the soil at their feet always cool and moist. Droughts they abhor as anyone can see when comparing the robust specimens in the damp Wisley woods with any struggling in the average dry border.

For interest, too, one should grow a few really striking plants like *Lobelia fulgens*, whose pillar-box scarlet flowers and crimson leaves show up brightly against any lighter shades or backgrounds. Although this plant is not always hardy, it is easily wintered in a cold frame and is too good to miss from our planting schemes. Although often seen in herbaceous borders, the bog is its real home, and when plentifully supplied with moisture it reaches fine proportions. *L. syphilitica*, which is perfectly hardy, will stand even wetter conditions and carries stocky spikes of sapphire or sometimes amethyst flowers. The two species have united to provide a deep violet variety called 'Purple Emperor.'

The bugbanes or cimicifugas are useful in late summer when the feathery white sprays tower above the dark green leaves. *C. racemosa* may grow 8 feet high when happily sited.

Hemerocallis have today left the Cinderella ranks of gardening and become established queens in their own right. No longer need the term "flower of a day" be used in a derogatory sense, for the plants have proved that given the right conditions, they can carry blooms on and off for months at a stretch. In Asia they are naturally found along the banks of streams, so that, although adaptable enough to grow almost anywhere, it is only when plentifully supplied with moisture that they give of their best. The Chinese used the dried flowers of hemerocallis for thickening soups and in noodles, and chewing the blossoms is reputed to effect a cure for toothache. Besides the well-known lemon and orange shades, modern varieties produce flowers in pink, cadmium, copper, chocolate and dark red.

For the front of the bog, mimulus are indispensable, the bright monkey faces—whether spotted or plain—bearing cheery evidence as to their well-being. There are a number of scarlets, including *Mimulus* 'Bees' Dazzler' and *M.* 'Whitecroft Scarlet,' but amongst the yellow-spotted forms *M.* 'Hose-in-Hose' is fun if only on account of its double corolla ring, which gives the effect of one flower sitting inside another.

There are, of course, many more spectacular bog plants, but mention should be made of the two water-loving iris groups—*Iris laevigata* and *I. kaempferi*—if only because they are so often muddled. The kaempferis or clematis-flowered irises are by far the most picturesque group for the bog garden; the colours varying through white, blue, red, violet, crimson and cream—often with bold and elaborate markings. As the petals are held in a horizontal position, they resemble a flock of gaily-hued butterflies when seen at a distance, and are really charming grown *en masse*. This group prefers a sunny position by the waterside, with an abundance of water during the growing season, but the plants are calcifuges and so must not be set on chalk. A rich soil is essential; in Japan the plants grow on land which is drained and heavily manured in winter and flooded with water in spring and summer. *I. laevigata* on the other hand shows less variation in colour, the flowers being mostly purple, but sometimes white, pink or blue and white. They are, however, useful in another direction, for they will grow *all the time* in water, a position which would prove fatal to the kaempferis. The uninitiated will find it easy to distinguish the two kinds if he examines the leaves. There is a prominent midrib running down the *kaempferi* leaves, which is missing in *laevigata*.

In the wetter parts of the bog garden the choice of subjects will be more restricted. Not every plant will favour constant moisture round the roots and amphibious subjects or near aquatics must be sought for these positions. The "Bog Bean" (*Menyanthes trifoliata*) and the "Bog Arum" (*Calla palustris*) are excellent scrambling aquatics for either wet ground or shallow water; both have a snake-like rootstock and both are

low-growing. *C. palustris* has small white arum-like flowers which have a singular claim to fame inasmuch as they are one of the few subjects which are pollinated by snails (Fig. 99). Water-snails attracted by their rather offensive odour crawl up the flower spikes, becoming covered with pollen from the staminate blooms and then on their return journey pass over and so pollinate the female flowers.

Calthas and water forget-me-nots also favour the wetter parts of the garden, as do the curious aroids, *Lysichitum camtschatcense* and *americanum* (Fig. 98). The pickerel weed of North America (*Pontederia cordata*) and the native flowering rush (*Butomus umbellatus*) are other useful " standbys " for the wetter parts of the bog.

But, perhaps, the most interesting subjects for the marshy areas are insectivorous plants, strange carnivores which seek to augment a diet lacking in phosphate and available nitrates by taking their nitrogen in the form of protein. Since aerobic bacteria are prevented from breaking down the vast deposits of vegetable material to its simple components—and plants generally are only able to utilize nitrogen in its simplest form (nitrates)—it follows that this essential element (so necessary for growth and leaf production) must be sought in other directions. Insectivorous plants have solved the problem by ensnaring insects, and have adopted ingenious devices for breaking down their bodies to nourish their own.

Sarracenias entrap insects through the medium of their variously mottled leaves, which are joined at the margins to make a pitcher-like tube and widen at the top in some cases to form a lid or hood. At the base of the pitcher lies a small quantity of mucilaginous fluid. Sticky secretions round the mouth and throat of the pitcher entice the prey, which after feeding find that the downward-pointing hairs through which they have scrambled prevent exit. After vainly floundering round and round, they eventually fall into "the pool of death" and drown in those lethean waters, their bodies contributing to the vigour and sustenance of the plant that has captured them. Before the war the late MR. SCRASE DICKINS grew quantities of *Sarracenia flava* and *S. purpurea* in his garden at Coolhurst and, in a bog in N.W. Ireland, *S. purpurea* has spread and naturalized itself so thoroughly that today it covers a wide area.

Pinguiculas are useful little bog plants, with pale green rosettes of succulent, greasy foliage and dainty purple or white flowers reminiscent of violets. For this reason they are often called bog violets, or sometimes butterwort. The latter name puzzled me for many years, but I believe its application can be explained by the following circumstance. Just before the war, my father-in-law, whilst plant-hunting in Lapland, noted on several occasions the natives gathering leaves of the *Pinguicula* and was interested enough to enquire the use for which these were intended. He discovered that later they were placed on sieves, which in turn were stood over buckets, and then milk, warm from the reindeer cow, was poured through the sieves. As it drained through and cooled

it gradually curdled, acting in fact in the same way as rennet does when this is placed in warm milk. The resultant substance (which was known as tatmölk), after seasoning, was spread on bread as butter.

Pinguicula vulgaris is the common bog violet found in many parts of the Northern Hemisphere. It grows about 6 inches high and has light purple flowers. *P. grandiflora* is a much better plant, with deep violet blossoms, but there are also white and sometimes bicolor varieties.

Droseras are known to holiday-makers in the Welsh valleys and the Lake District. They are found growing in bog land, muddy soil and at times even in hummocks in the water itself. The foliage is produced in spreading rosettes, usually close to the ground, each leaf closely covered with glandular hairs which exude a colourless sticky fluid. The victim, enticed by the spangled, dewy appearance of the leaf, alights, only to stick fast where it touches. The rest of the hairs—by some telepathic means of communication—react, and bend over the unfortunate insect until it is smothered and succumbs. Exudations on the leaf glands then absorb the soft parts of the creature's body and the resultant ferment (after digestion) serves to nourish the plant.

There are, of course, countless other plants for the bog garden. Many ferns favour the moist conditions of the woodland areas, and bulbous plants like trillium, camassia, narcissus species and leucojum are at home in the better-drained areas.

Of Titanian proportions for the larger garden is the rhubarb-like *Gunnera manicata*, a giant, indeed, whose mammoth leaves are sometimes 10 feet or more across. This plant should always have abundant moisture at the roots, so the chosen site should be well prepared, with plenty of decayed humus incorporated in the soil. In autumn, when frost spoils the leaves, they should be cut down and inverted over the crowns. Here they will rot away, affording an excellent mulch, and also serve as protection during the coldest weather.

The hostas or Japanese Plantain Lilies are invaluable subjects for waterside planting, and the large glaucous or variegated leaves command attention throughout late spring and summer. At the water's edge, water forget-me-nots with starry blue florets rest in the shallows. Here, too, one may grow the double marsh marigolds (*Caltha palustris plena*), whose golden buttons in spring rival the sun itself in intensity of colour. They are excellent plants for the darker parts of the bog garden, as they are among the first plants of the year to flower—"shining like fire in swamps and hollows grey."

In the shallows, where the water trickles over grey-white stones, *Onoclea sensibilis*, *Dryopteris thelypteris* and the Royal Fern (*Osmunda regalis*) lave their feet.

Many more beautiful plants, dwarf and tall, woody and herbaceous, might be included in the bog garden surround, but the few mentioned in this short survey will serve to show something of the wealth of material available to the bog gardener, and all those indeed whose soil is in the happy condition of being constantly moist.

MODERN CARNATIONS AND PINKS

Montagu C. Allwood, F.L.S., V.M.H.

(*Lecture given on July* 12, 1955, MR. G. W. LEAK, V.M.H., *in the Chair*)

THE Ancient Greeks were a wise race of people and had the wisdom to name that adorable race of plants, the jewels of the ancient world, *Dianthus*, meaning divine flower.

Could any name be more happy for a race of ancestors so adorable, especially when we consider all the modern development of our carnations and pinks whose origin was the ancient flower?

This has only been brought about during more recent years, whereas all other plants, such as dahlias, roses, chrysanthemums, orchids, etc., were worked upon and developed many years ago.

There are more than a hundred species of *Dianthus*. However, I have a very shrewd suspicion that many of these are only natural hybrids; at least, there are very few of them which are definitely distinct.

FAMOUS ANCESTORS

The five *Dianthus* species which have helped to make our present-day races are:

Dianthus caryophyllus, the ancestor of the border carnation.
Dianthus plumarius, the parent of the garden pink.
Dianthus knappii, the yellow dianthus.
Dianthus barbatus, the sweet william.
Dianthus chinensis, one of the ancestors of the annual or marguerite carnation, which is, undoubtedly, an outrageous mongrel—today it is generally known as Chabaud carnation.

The development of the perpetual-flowering carnation has taken place in our generation. France conceived it under the name of remontant carnation; then America took up the plant and called it the American carnation. England, at that time, had what was known as the tree carnation, but thirty years ago we christened it the perpetual-flowering carnation, the name by which it is generally known in Europe, but in the New World it is called "The Carnation," the name which I imagine will eventually survive.

This important plant is, undoubtedly, a hybrid between the British border carnation and the Continental marguerite type. This fact is still visible in many present-day seedlings, in their growth and flowers, although it is becoming less pronounced. However, this is the plant which has revolutionized the carnation and pink world because it has and is proving to be such a vital parent and if we could look, say a hundred years ahead, we should be more than surprised. Its influence is seen today in the miniature alpine dianthus, also the lordly

malmaison carnation, yet this is only the beginning of the development.

We all should realize that in the large and happy *Dianthus* genus, more than with any other race of plants, for as Nature decreed, certain of the species for generations refused to be intermixed with other species. In fact, it is only during recent years that hybrids have been developed which have unlocked the door and revealed all the wonderful new kinds of pinks and carnations we have today.

The interesting fact is that fifty years ago these developments were not possible and the *Dianthus* genus was to a large extent restricted to the old world. This is indeed evolution in our time.

It is a most interesting fact that in the Middle Ages the old type of carnation in this country was looked upon as the aristocrat of the floral kingdom. The display of these flowers gave atmosphere to the occasion; it was an event of importance when carnations decked the board, which showed that ladies with good taste were concerned with the arranging of the function. As we know, flowers elevated the occasion from just a drinking, gluttonous brawl to a refined and elegant banquet.

In time, the carnation itself began to fail, whether because it was puffed up with pride, as I believe, or indulged with too rich a living in soil, manure and so forth, but it became a pampered pet and lost the hardy virtues of its ancestors and so was under a cloud for several decades.

Happily, today, the carnation has won back its rightful position as one of the greatest of all flowers, while the pink has been elevated to the prominent position it now holds in the floral kingdom. In fact, today, a garden is not a garden which does not contain some species of them, more especially because the modern forms do not require staking or other attentions; also, they are almost proof against pests and diseases.

GARDENERS' INHERITANCE

All horticulturists are inclined to minimize the importance of their calling. Few, if, indeed, any, people are of greater value to their fellow men than we gardeners. To appreciate this, think what this world would be without flowers. The very fact that flowers were created at all to beautify the earth emphasizes their importance, so that all of us who grow them are working in harmony with Nature, also, those of us who introduce new kinds should consider ourselves highly privileged. Flowers, more than anything else, influence our minds and thoughts, which I believe are the most precious part of us. So this makes the calling of the gardener no mean calling. Few indeed can deny it. This you can see for yourself if you compare the happy expressions of those attending a flower show with those you see at, shall we say, a race meeting or some athletic event.

We, who are associated with flowers, should count ourselves more than fortunate because of their very great power for good. Today in this modern, mechanized, noisy world, the quiet influence of flowers and living things is more essential than ever before.

It is a privilege to be allowed to work trying to improve and develop new flowers, particularly those which grow so well in the new world and link it up with the old world.

One thing we gardeners who work in conjunction with Nature realize more than others do is the tremendous power of Nature. The seasons of the year we are apt to take as a matter of course, yet they are perhaps, the greatest power of all; people who live artificial lives out of touch with the seasons are robbed of the quiet, calm influence of Nature. They cannot fully appreciate its tremendous power, and, also, they miss much of that which is best in life.

THE TREMENDOUS INFLUENCE OF THE PERPETUAL-FLOWERING CARNATIONS

In horticulture things are happening all the time and it is only when we look back with any purpose that we realize it and to do this you must have passed three score years and ten. We old people are in the privileged position of being able to make comparisons, because we know the state of things half a century ago. There is a good deal of joy in all this, especially with the old garden carnation and pink; everything remained more or less the same as it had been from the Middle Ages, until the evolution of the perpetual-flowering carnation changed the whole scene.

Also remember this, the old forms of border carnation and garden pinks did not live long nor flourish well in the hotter climates of the New World but the new perpetual-growing and flowering strains have made them one of the most popular plants. That, I contend, is evolution at its best. All these things happen in the horticultural world but the general public do not fully appreciate the tremendous strides horticulture makes so as to keep in step with the modern world. If it were some new kind of aeroplane or motor-car, the press would be full of the wonderful development. In horticulture, as with Nature, there is little drum-beating or shouting from the housetops and few honours, if any, are given.

BORDER CARNATIONS

These are generally known to be the oldest race of carnation and descendants of the wild species *Dianthus caryophyllus*. However, this plant has not moved with the times and is in danger of becoming out of date. It cannot compete favourably with the modern forms of other garden plants, which flower for an extended period; also, the great developments which have been made in the pink is making the pace too hot for the border carnation, which costs more to grow than the modern pink and does not produce so many flowers.

I personally think that the reason this beautiful flower is in danger of losing favour is because the Border Carnation Floral Committee has set too rigid a standard for the flower and plant. The old standards must be modernized and modified to keep in touch with the requirements and

tastes of the new generations. What is wanted, to my way of thinking, is a plant which grows like the modern pink, but has the colours and exquisite form of flower of the old type of border carnation.

Until comparatively recently the orthodox border carnation enthusiasts and committees were actively opposed to the perpetual-flowering carnation and resisted any tendency to introducing its influence, but, after all, where would the carnation stand today among the aristocrats of the floral kingdom if it were not for this type?

This to my mind underlines the fact that if you are a member of any Floral Committee it is essential to strive to maintain a progressive, fair and open mind or you will become an enemy of the flower you are supposed to serve.

My ideal for the border carnation would be a plant with the thinner silvery foliage of the picotee border type and instead of the layers or new basal shoots lying dormant until flowering the following year they should immediately rush into bloom. The secret would be to cut the flowers with long stems so that the plant is automatically pruned and kept as a tufted compact plant which needs no stakes or artificial supporting. Such a plant would be an ornament in any garden every day of the year.

AMATEUR CARNATION

(half perpetual-flowering and half border carnation)

This new race of plants is on its way and official trials are being held to prove its hardiness and to estimate its value as a race of desirable garden plants, which may endear itself to the garden lover in the same way as the old crimson clove and 'Rifleman' border carnations have done. This new race is still in its infancy, yet the great possibilities should be plain to all.

Amateur carnations, being a blending of the two popular races of carnation, resemble the border carnation and have a short compact habit of growth and so they are ideal for the cold or cool greenhouse, where they flower all the year, but their real value will be appreciated in Australia, Africa, Mexico and so on, where they should become a popular garden plant.

NEW TYPE OF MALMAISONS

This is a giant-flowered race of carnation with the distinct form of the Edwardian Souvenir de la Malmaison 'Princess of Wales'; this was of French origin. Then English raisers produced a number of varieties all of which were sterile in themselves. Now the perpetual-flowering carnation has thrown off some malmaison seed sports which are fertile and perpetual flowering, and, although the seed is difficult to obtain, it will be produced more freely in the course of time, and, eventually, make a giant race. However, some of the flowers from this new malmaison are phenomenal in size, up to 9 inches in diameter and of the true Malmaison form with the clove perfume. So here is a plant which should have a great appeal in the New World, where large flowers are

much appreciated. Time alone can decide its usefulness, but it might easily create a new floral fashion and revive the great days of Edward VII and Queen Alexandra.

PICOTEES

Our grandparents greatly prized picotee-coloured carnations. They had a French origin, but in the Victorian era they so captivated the public that the National Society called themselves The National Carnation and Picotee Society. Today all the best of the old varieties are in cultivation. However, a perpetual-flowering strain of these has been developed. Years ago I noticed a seedling perpetual-flowering carnation which had, undoubtedly, picotee markings, and after years of work in cross-fertilizing these we have developed a race of plants which I think are remarkable because they reproduce themselves true to type in colouring from seed, a thing unheard of even twenty years ago. Some have heavy edges, others thin wire edges, in new and wonderful colourings of extreme beauty, at least in my eyes.

THE PINK

As a small boy, when I was privileged to have a wee garden of my very own, the only plants I would grow in it were the adorable old-world plants, the pinks. In fact, I could not quite understand why people grew any other plants for the garden and today I hold very similar views, except that I prefer them in their modern form.

Forty years ago, by crossing the perpetual-flowering carnation on to the oldest of all the garden pinks, 'Old Fringed White,' in the course of years I developed the perpetual-flowering pink, which the Scientific Committee of the R.H.S. named *Dianthus allwoodii*. This plant has now revolutionized the dianthus world, not only in the development of the habit of the plants but by developing new colours and reviving some of the old ones which we once thought were dead, and also producing many wonderful hybrids in various races of *Dianthus* (Fig. 100).

PERPETUAL LACED PINKS

The laced pink, the old favourite of the early Victorian era is being re-established and also developed and is much hardier than its forebears. The range of colours is being enlarged; the ground colour was white in the old varieties but now we are getting pink, red and other ground colours and they are perpetual flowering from spring to winter, because they have been crossed with *D. allwoodii* (Fig. 102).

One of the great joys of the laced pinks is their ever-increasing popularity and development as garden plants and not as pampered pets for exhibition purposes alone. I am convinced of this, that in the future we shall see great developments in the laced pink family.

SHOW PINKS

The show pink is the aristocrat of the pinks—it is really a secondary hybrid. Years ago, MR. HERBERT of Birmingham developed his race of

pinks from border carnations × laced pinks; it was a very beautiful strain with delightful colours in perfect pink markings, but it was not perpetual flowering. However, by crossing these with *D. allwoodii*, the show pink was obtained with all its beauty of form and colour to satisfy the exhibitors, or those people who can appreciate super quality. This race of plants has in a wonderful way caught the fancy and imagination of the public, especially in growing them from seed, in the hopes that a perfect-flowered plant will crop up. Such is the gambling instinct of our people!

RACE OF YELLOW PINKS

A double-flowered yellow pink has been the dream of gardeners since the Middle Ages. We raised the first yellow pink five years ago; it was called 'Yellowhammer.' This is being accompanied this year by a richer-coloured variety which is being called 'Goldfinch.' We are developing a strain of these yellow- and apricot-coloured pinks and shortly we shall be able to supply seed which will produce flowers of various shades of yellow and apricot, so if you live in the uttermost parts of the earth these can be sent to you by post. All this to me seems rather wonderful, because their ancestors have existed in the world for hundreds of years, but it is only in recent years that developments have taken place. The yellow species *D. knappii* × *D. allwoodii* is the ancestor of the yellow pink, which is in its infancy. It is like a new pigment in an artist's hand.

ALPINE DIANTHUS

The perpetual-growing and flowering rock pink *D. allwoodii alpinus* was brought about by crossing *D. allwoodii* on to dwarf *Dianthus* species such as *D. alpinus*, *D. caesius*, *D. neglectus*, etc. This I have always conceded to be my best work, because it has founded a very dwarf race of plants with tufted silvery foliage. Its great variety of colours in both double and single flowers is such that there must be tremendous possibilities for its future development, because it seems to have all the virtues in colour and perfume of its many ancestors, but with the great addition of a perpetual-flowering growth from spring to winter.

I often imagine that those who are not familiar with this hybridizing work must imagine that it is like an artist mixing his paints on the palette, but it is not so simple as that, because it is often very difficult actually to effect the cross. Nature does not surrender her jewels freely but to obtain your ideal, which may take several years and the cost of raising thousands of useless seedlings, first of all you must have the knowledge. But the real secret of it all is judgment. This is something you cannot get from books; it is only obtained by observation.

D. 'SWEET WIVELSFIELD'

This was the first fertile hybrid raised from sweet william (*D. barbatus*). The early hybrids in which the border carnation was used as a male parent only produced a race of plants named "Mule Pink," of

which the old catalogues have a list of many varieties in various colours, but when I used *Dianthus allwoodii* it produced this wonderful race of plant, *Dianthus* 'Sweet Wivelsfield,' not unlike the old sweet william in growth yet with a larger and more varied range of colour. These have naturalized themselves in the New World, but we note that the strains deteriorate in warm climates, such as Africa, South America, Australia, etc. As we know, this is what happens with our races of animals, such as sheep and cattle, all of which goes to show the wonderful advantage we have in this country in the matter of climate—a fact which we all at times are apt to forget. Also dianthus grown from seed produced in this country has stronger constitution than that from seed produced in hotter climates.

D. 'LOVELINESS'

A hybrid between 'Sweet Wivelsfield' and *D. speciosus* (I used the dwarf sport known as *wimmerii*) which is exceedingly hardy and flowers from May to winter is, perhaps, the most fragrant of all flowers. The petals are very lacerated and give a pleasing misty effect. Another advantage of this race of dianthus is that we have been able to fix many colour strains such as white, crimson, blue, etc., which will flower true from seed. These can be sown at any season of the year. However, early spring is, undoubtedly, the best. I think *D.* 'Loveliness' will be the parent of some rather wonderful developments in the near future, which should further enrich the race, and double-flowered types are possible.

D. 'DELIGHT'

This is a hybrid between 'Sweet Wivelsfield' and *D. roysii* (an offspring from *D. alpinus*). The plant grows some 9 inches high and resembles both its parents, but the colours are almost bewildering in their range and beauty. The flowers are single and are produced in trusses in great profusion from spring to winter. An interesting fact about it is that the reflex of the petals has a metallic colouring like *alpinus* (Fig. 101).

D. 'SWEETNESS'

A secondary hybrid between 'Sweet Wivelsfield' and *D.* 'Loveliness,' this plant seems to be endowed with the virtues of both its parents and to have the balance between them in habit of growth, perfume, etc. The flowers have many self colours, such as crimson, pink, etc., but its hardy constitution and habit of growth are its main virtues. I think it will eventually become a famous cut-flower plant because the more flowers you cut the more you get; also, these last well when cut.

CUT FLOWERS

Half the value of any plant is its use as a cut flower in the dwelling house; for this service they should have reasonably long stems with good keeping qualities, and also the added virtue of perfume. All these

virtues are exactly what the various carnations, pinks and hybrid dianthus have.

I am convinced that some of us have not displayed the many merits of these races of *Dianthus* so well as we could or indeed should have done. For instance, a mixed vase of carnations and *D.* 'Loveliness' is more than attractive, the one acting as a contrast or foil to the other. However, it is the range of colour which gives the floral artist such a wide scope, especially when using large and small flowers together.

Generally speaking, a mixture of flowers in various types is more attractive than just one variety of one colour alone; indeed there is endless scope for all the art that any florist possesses.

A MIRACLE

It has always appeared to me more or less a miracle that these modern hybrid races of *Dianthus* will reproduce themselves true to type from seed; one would naturally have thought that one of their wild parents would dominate, yet this does not happen—it seems as if nature herself intended these developments to take place.

The value of all this is that they are easily transported to all countries of the world and, being perpetual-growing, they are admirably suited to the hotter climates where they do not, as their ancestors did, require a dormant or resting period to preserve their health and vigour. These hybrids revel in the warm conditions of the new world—surely this is evolution at its best, because the species are only found in the old world, yet in their modern, and I think improved, form they flourish everywhere.

SEED

There are advantages and disadvantages in plants that reproduce themselves from seed, because if you allow them to seed it saps their vitality and shortens their life, so it is wise to remove the faced flowers or, better still, keep the flowers cut for house decoration, because the more flowers you cut so much the more flowers the plant will produce.

However, in the case of large double-flowered kinds of carnations and pinks the conditions have to be most favourable for them to produce seed naturally. The modern forms are only persuaded to produce seed under most favourable conditions under glass in this country. It is all too true that weeds or inferior types seed freely and one wonders at the colossal impertinence of some people in putting these into a seed packet and charging money for them!

SOWING SEED

There is much truth in the old term "green fingers" although it all amounts to a matter of that sense which we call common; the instructions on the packets are, undoubtedly, the best advice obtainable.

Naturally, the seeds prefer light sandy soil in which to germinate and a warm sunny position until the seedlings are matured. However, the best dates of sowing are most important; it is always better to be too

early than too late. Seedling plants are surprisingly hardy in well-drained soil, so as a general rule early spring and early autumn sowings are best, but the great interest of gardening lies in experimenting because no two soils or districts are identical and as these plants carry on for one or two years it is all well worth while.

CULTIVATION

I have often written and spoken about the cultivation of the carnation, pink and other members of the *Dianthus* genus and have always contended that it is futile to endeavour to dictate to Nature, and that wise gardeners work in harmony with her.

We know and have proof today that almost all the wild dianthus have naturalized themselves upon limestone mountains and so for their successful cultivation all that is necessary is to imitate the conditions you will find there, in the matter of a good light, air circulating round the plants, good change in the soil, which should be sweet with some lime or chalk in it—the soil would not be excessively rich on a mountain—and so on.

Another attraction of these hybrid dianthus is that you can flower them all the year round in a cool greenhouse in the same way as perpetual-flowering carnations, in which case the seed should be sown in early spring or summer.

With many of us a garden is a sacred retreat and I suppose that most of us will agree that the most important things in life are those which create happiness and promote pleasant thoughts which evoke memories. I take it that the mission of flowers is to do this; if it were not so why are they upon the earth at all?

So we see that flowers in reality have a most prominent position in our lives, and that *Dianthus*, "The Divine Flower," is no mean race of plants; in fact, it may be the most famous and become the most popular of all plants. You may have noticed, too, how each plant or flower has its vogue of popularity in the history of the world.

In the days of Queen Elizabeth I, carnations were the leading flower of fashion and were included by artists in many of their paintings of the most famous people of the time, paintings which we can see today; so what could be more fitting in these great days of Queen Elizabeth II than that the *Dianthus* should once again establish itself as the first flower in the floral kingdom?

PLANTS TO WHICH AWARDS HAVE BEEN MADE IN 1955

Begonia serratipetala A.M. March 8, 1955. A species from an altitude of 8,000 feet in New Guinea, introduced by the exhibitor. It is of spreading habit, with stems about a foot long bearing at short intervals obliquely ovate-lanceolate, coarsely toothed leaves which are of a metallic bronzy-green colour above and red-purple beneath, the upper surface being marked with red pustular spots. The somewhat inconspicuous rose-pink flowers are borne in short, axillary racemes. Exhibited by L. Maurice Mason, Esq., Talbot Manor, Fincham, King's Lynn.

Bergenia (beesiana × delavayi) 'Ballawley' A.M. May 3, 1955. A herbaceous plant raised by Mr. Smith-Shaw at the Alpine Nurseries, Ballawley Park, Dublin. It has large, leathery, broadly-ovate leaves 10 inches long on stout stalks, and tall, blood-red, freely-branched scapes bearing 1 inch wide flowers of Fuchsia Purple (H.C.C. 28). Exhibited by the Director, Royal Botanic Gardens, Kew.

Columnea × banksii A.M. April 19, 1955. A valuable hybrid *Columnea* raised at Cambridge Botanic Garden many years ago from a cross between *C. oerstediana* and *C. schiedeana*. It has long, pendulous growths bearing neat, oblong-lanceolate, two-ranked leaves and tubular russet-orange flowers 3 inches long. Exhibited from the R.H.S. Gardens, Wisley, Ripley, Surrey.

Galanthus caucasicus A.M. April 5, 1955. This handsome, late-flowering snowdrop has two broad, glaucous leaves and a scape 6 inches tall bearing a large flower with broad outer perianth-segments an inch long. Exhibited by the Commissioners of Crown Lands, Windsor Great Park, Berks.

Magnolia × loebneri 'Leonard Messel' A.M. May 3, 1955. This interesting hybrid originated at Nymans from a chance cross between *M. kobus* and *M. stellata* var. *rosea*. The flowers open before the leaves expand, and are composed of about twelve narrowly strap-shaped petals 3 inches long, coloured outside Cyclamen Purple (H.C.C. 30/2), and at length spreading widely to reveal the almost white inner surface. Exhibited by Mrs. L. C. R. Messel, M.B.E., and the National Trust, Nymans, Handcross, Sussex (Fig. 104).

Paeonia 'Defender' F.C.C. June 14, 1955. A very handsome single variety with satiny Indian Lake (H.C.C. 826) flowers borne on sturdy stems and measuring 6–7 inches across with a large central mass of golden anthers. It was raised by Prof. A. P. Saunders of Clinton, N.Y., U.S.A., and received an **A.M.** on June 9, 1953. Exhibited by Messrs. Thomas Carlile (Loddon Nurseries) Ltd., Carlile's Corner, Twyford, Berks., and Mrs. Gwendolyn Anley, St. George's, Wych Hill Lane, Woking, Surrey.

Paeonia 'Legion of Honor' A.M. June 14, 1955. A variety raised by Prof. P. A. Saunders in the U.S.A. It has stiff, 3-foot stems bearing bright, lustrous green, bipinnatisect foliage and solitary terminal flowers over 5 inches across. The widely saucer-shaped flower is composed of about sixteen obovate, crimped, Rose Red (H.C.C. 724) petals enclosing a bold crown of green, rose-tipped pistils. Exhibited by Mrs. Gwendolyn Anley, St. George's, Woking.

Paeonia 'Louis Henri' A.M. June 14, 1955. A shrubby paeony raised in France, probably from a cross between *P. suffruticosa* and *P. lutea*. The flower is over 6 inches across, and has about thirteen deeply incised and crimped petals enclosing a mass of golden stamens. The colour of the petal is creamy-yellow, suffused with Claret Rose (H.C.C. 021/3) and stained with crimson at the base. Exhibited by Capt. Collingwood Ingram, The Grange, Benenden, Kent.

Paeonia 'William Cranfield' A.M. June 28, 1955. A very handsome single variety with large Persian Rose (between H.C.C. 628/1 and 628) flowers measuring 7 to 8 inches across and having a central mass of yellow stamens each with a small streak of rose. It was raised by the late Mr. W. B. Cranfield, V.M.H., F.L.S., under No. 18 and the stock was purchased by the exhibitors at the sale after his death. Exhibited by the Commissioners of Crown Lands, Windsor Great Park, Windsor, Berkshire.

RHODODENDRONS

Rhododendron anthopogon A.M. May 3, 1955. An attractive, low-growing shrub found naturally high up in parts of the Himalayas. Each truss is made up of about ten blooms formed into a tight, small globe. The flowers are coloured Fuchsine Pink (H.C.C. 627/3), which, on ageing, fade to a darker shade. Exhibited by Mrs. L. C. R. Messel, M.B.E., and The National Trust, Nymans Garden, Handcross, Sussex.

Rhododendron coelicum A.M. April 19, 1955. The singular characteristic of this rhododendron is its leathery leaf blade covered on the under surface with a particularly thick and attractive tomentum. This covering is cinnamon-coloured and is dense enough to hide all the primary veins. About twelve flowers make up the tight, rounded truss with each flower of a fleshy nature, containing five pouches in the tube and coloured a dark shade of Oriental Red (H.C.C. 819/3). Exhibited by Col. The Lord Digby, D.S.O., M.C., T.D., Minterne, Dorchester, Dorset.

Rhododendron (megeratum × mishmiense) 'Moth' A.M. May 3, 1955. As a tender plant, this rhododendron must be afforded the protection of a cool greenhouse. The leaves are $1\frac{1}{2}$ inches × 3 inches long, broad-lanceolate, are scaly beneath and have ciliate margins. Six flowers make up the loose truss. The corolla is $2\frac{1}{4}$ inches × $1\frac{3}{4}$ inches long, flat-campanulate and has large, slightly recurved lobes. In colour the flowers are Lemon Yellow (H.C.C. 4/3–H.C.C. 4/2) and the upper lobes are heavily spotted with brown. The filaments are also yellow and

the anthers dark brown. Exhibited by Lord Aberconway and The National Trust, Bodnant, Tal-y-Cafn, Denbighshire.

Rhododendron obtusum var. kaempferi F.C.C. May 24, 1955. A description of this plant may be found in the R.H.S. JOURNAL 78, 302. Exhibited by Commissioners of Crown Lands, Windsor Great Park, Berks.

Rhododendron pubescens A.M. April 19, 1955. This rhododendron makes a small shrub up to 6 feet high and has rather a spreading habit. It flowers freely every year displaying an abundance of small, axillary flowers at the apex of each shoot. The small, narrow-lanceolate leaves are slightly revolute at the margins and covered on both sides with long hairs. On the flower stalk is a dense, pubescent covering, together with some scales, while the rudimentary calyx is fringed with long hairs. The corolla is ¾ inch × ½ inch long and has deep lobes. In colour the flowers are white suffused with varying shades of Persian Rose (H.C.C. 628/1), and the buds a deep shade of pink. Exhibited by Commissioners of Crown Lands, Windsor Great Park, Berks.

Rhododendron rex A.M. May 3, 1955. Owing to its size this plant can be seen at its best only in large gardens. Under such conditions, it makes a tree 20 feet high with characteristically thick branches and stout flowering shoots. The leaf is about 4 inches × 12 inches long, narrow oblanceolate, with a distinctly obtuse base and the underside covered with a thin, hard, brown tomentum; petiole 3 inches long, stout, tomentose. Each flower is 3 inches across, tubular-campanulate and in colour, white with a faint pinkish-blue tinge, a deep crimson blotch in the base of the throat and scattered, crimson spots on the upper lobes. Exhibited by Commissioners of Crown Lands, Windsor Great Park, Berks.

Rhododendron roseum A.M. May 24, 1955. Flowers on this species appear as the leaves expand. The flower stalk and calyx is pubescent and the corolla funnel-form, the limb being 1¼ inches across and the pubescent tube ½ inch long ; in colour the flower is Phlox Pink (H.C.C. 635/2) with the tube and unopened buds a slightly darker shade. This delightful addition to our gardens from eastern North America is an important one, for, apart from its rich fragrance, the plant is a most accommodating one and will thrive in situations unsatisfactory for many of its congeners. Exhibited by Mrs. Roza M. Stevenson, Tower Court, Ascot, Berks.

Rhododendron sinonuttallii, A.M. May 24, 1955. This is a shrub for the cool greenhouse. Its elliptic leaves are 4 inches × 8½ inches long and the margins gently waved; on the underside, the mid-rib and lamina are densely scaly. Up to six nodding flowers are in a lax truss. The pedicel is 1 inch long and scaly and the translucent calyx ½ inch × 1 inch long. The colour of the large corolla with its reflexed, waved lobes is white with sparse, pale crimson markings on the outside; inside the throat there is a pale orange stain. Exhibited by Messrs. The Sunningdale Nurseries, Windlesham, Surrey.

BOOK NOTES

"Natural Rock Gardening." By B. H. B. Symons-Jeune. Roy. 8vo. 166 pp Illus. 3rd Edition, revised. (Country Life.) 30s.

Mr. Symons-Jeune's book *Natural Rock Gardening* might almost be described as a "Counsel of Perfection." However, it is not given to many to arrive at perfection without an apprenticeship which generally includes much in the way of trial and error.

Undoubtedly, the gardens designed by Mr. Symons-Jeune are beautiful and show the hand of the artist, but everyone is not an artist and in spite of the very clear instructions he gives it is doubtful if many people could achieve the same results. His "Requirements of a Rock Garden" are essentials that every prospective constructor of a rock garden should read and apply. The chapters on conifers and stone chippings should be perused with care—the proper use of these can make all the difference between success and failure. Instructions on the placing of plants and arranging for colour effect in winter are excellent, as are also those dealing with the many effective uses of rock pools and running water.

To sum up, this book though excellent in every detail including the many illustrations has two drawbacks from the amateur's point of view: (1) the cost would put such rock gardens beyond the means of most people; and (2) generally speaking the constructional work, to be successful, would have to be undertaken by, or under the direction of, a professional landscape gardener.

GERALD K. MOONEY

"Climates in Miniature. A Study of Micro-climate and Environment." By T. Bedford Franklin. 137 pp. Illus. (Faber & Faber, London, 1955.) 15s. net.

Horticultural textbooks commonly speak in vague terms of "sheltered situations," "wall protection," "frost pockets," "buoyant atmosphere" (a particularly pernicious example) and similar undefined expressions. Few amateurs, or commercial growers, take the trouble to find out for themselves, either by personal experiment or by reference to scientific works, just how much protection a wall or a cloche will give to plants, or what effect damping-down of a glasshouse has upon the humidity of the air and for how long.

Mr. Franklin has done a real service to the amateur who reads his book, if only in making him think about these things and using more common sense in siting, growing and protecting his plants. The author has obviously spent many years in studying and experimenting with simple instruments and practical devices to discover just what does happen to the temperature and humidity of the air, and the moisture and temperature of the soil in localized areas by comparison with the general ambient conditions. He writes entertainingly as well as informatively and there is much interesting ecology and natural history interspersed throughout. Many growers as well as keen amateurs who want to learn more about the conditions under which they grow their plants, would profit from reading this book.

R. H. STOUGHTON

"Balanced Steaming of Glasshouse Soil." John Innes Leaflet No. 14 8 pp. (Oliver & Boyd Ltd.) 1s.

This leaflet is concisely written and filled with information dealing with the necessity for sterilization, the preparation of the soil, the apparatus required and the actual process with relevant tables. It should be noted that leaflets are not available from the J.I.H.I. but from the publishers or booksellers.

"The National Vegetable Research Station. Fifth Annual Report, 1954." 74 + vi. pp. Illus. (Nat. Veg. Research Station.)

Beside the report of the Director there are papers of importance on plant breeding, by J. C. Haigh, the synonymy in lettuce varieties, by L. E. Watts, and the effect of Krilium on the yield of certain vegetables, by F. Haworth and J. A. Nelder. Other papers cover reports on irrigation, entomology, plant pathology, weed investigations and weather.

"Soil Block Gardening." By J. L. H. Chase and A. J. Pouncy. 130 pp. Illus. (Faber & Faber, London, 1955.) 15*s. net.*

To those whose experience with soil blocks is confined to their use for tomato seedlings, it may seem surprising that a whole volume could be written on the subject. The authors of the present book are so enthusiastic that they advocate the use of blocks for almost all kinds of plants. The main arguments in favour are the greater volume of soil available to the young plant for the same bench space, the avoidance of root damage on planting out and the saving in labour in potting-off and similar operations. The authors admit that the economics of soil block use have not been worked out but feel confident that they will compare favourably with those of conventional methods.

The book contains much useful horticultural advice interwoven with the specific directions for the use of blocks and any keen amateur reading it will be fired with the desire to try the methods for himself. He might do much worse; in many cases he will at least have a greater margin of safety if he is a part-time gardener.

R. H. STOUGHTON

"Everyday Gardening." By J. Coutts, revised and edited by G. H. Preston. 416 pp., Illus. (Ward, Lock.) 21*s.*

"All about Gardening." By J. Coutts, revised and edited by G. H. Preston. (Ward, Lock.) 15*s.*

Both these works which cover approximately the same ground have been through a number of editions and undoubtedly contain much valuable information for the amateur, as might be expected from the status at Kew of the original author and present editor. It is unfortunate that a large proportion of the colour illustrations are produced in both volumes and it is distressing in a book of the kind of *Everyday Gardening* to see a painting of a hippeastrum appearing under the name *Amaryllis belladonna* while the text clearly describes the true South African plant. Experience at Wisley, however, would refute the suggestion that they do not flower freely in the cool greenhouse.

"Rock Gardening." By G. K. Mooney. Amateur Gardening Handbook No. 12. Illus. (Collingridge.) 3*s.* 6*d.*

As President of the Alpine Garden Society, Capt. Mooney is an acknowledged expert on the growing of rock plants and into this little book he has managed to pack concisely and clearly much useful information. There are general chapters on construction and planting, special forms of rock gardening such as the Scree and Moraine, the Dry Wall and even the Lily Pool, the Alpine house and propagation. These are followed by alphabetical catalogues of useful plants with short descriptions.

His brief remarks are invariably to the point and appropriate and the book can confidently be recommended to all those intending to embark on this fascinating branch of gardening.

PATRICK M. SYNGE

"Winter-Hardy Azaleas and Rhododendrons." By Clement Gray Bowers. 112 pp. Illus. (The Massachusetts Horticultural Society, Boston, Massachusetts, U.S.A.) $3.

One can only admire the enthusiasm and perseverance of those rhododendron lovers in the N.E. States of the U.S.A. whose plants are subject to the sub-zero winters and hot summers of that region. Dr. Bowers in his little book sets out to advise, in his own words—"the myriads of amateur gardeners"—on choice and cultivation of suitable species and hybrids. The number of those of proven hardiness will probably surprise growers in this country. As such the book will be of much value to rhododendron lovers who are forced to garden in the colder parts of Great Britain.

There are chapters on soil, site, planting and maintenance, in addition to descriptive lists arranged by series and hybrid groups. The style is lucid and the subject matter "deep" enough to suit the rhododendron enthusiast without confusing the beginner.

Pests and diseases are briefly dealt with. A surprising omission is Bud Blast, an American export to this country. The book is well illustrated, but the price, $3, is high when judged by British standards.

FRANCIS HANGER

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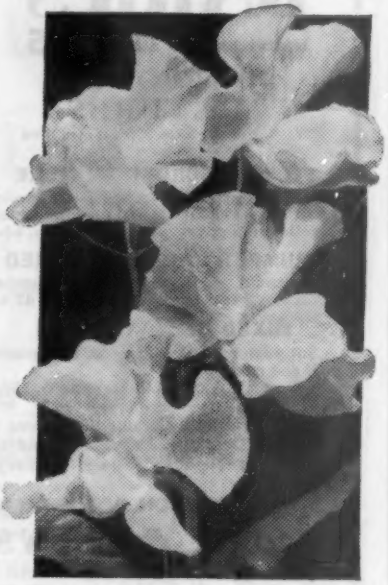

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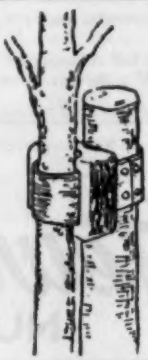

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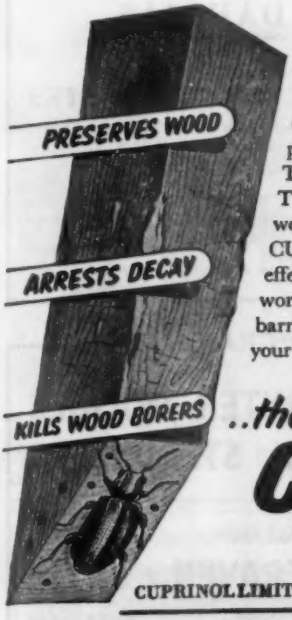

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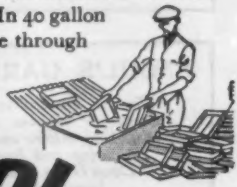

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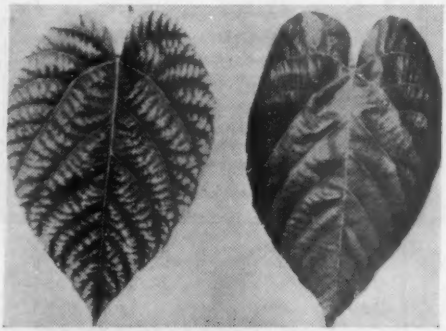

The tung tree (*Aleurites fordii*) and mu tree (*A. montana*), produce fruits from which oil is obtained for industrial uses. Both are susceptible to manganese deficiency.

Left: Typical 'frenched' tung leaf showing considerable chlorosis.

Right: Leaf dipped in manganese sulphate solution—photo taken five weeks after treatment.

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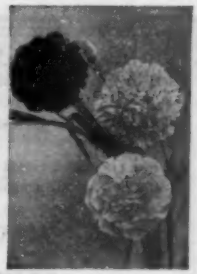

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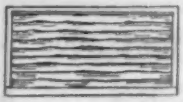

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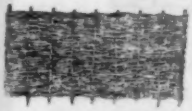

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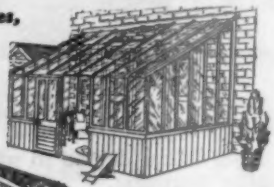

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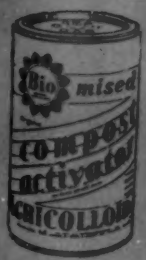

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